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HOW THE R.A.F. WORKS

By the same Author

WAR NEWS HAD WINGS

A RECORD OF THE R.A.F. IN FRANCE

Second edition

HOW
THE R.A.F. WORKS

by

A. H. NARRACOTT
Air Correspondent of *The Times*

With a Foreword by

THE RT. HON. SIR ARCHIBALD SINCLAIR, M.P.
Secretary of State for Air

With Illustrations

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THIS BOOK IS DEDICATED TO THE PILOTS, FLYING AND GROUND CREWS OF THE ADVANCED AIR STRIKING FORCE WHO WORKED AND DIED SO BRAVELY IN FRANCE—AND TO THOSE WHO LIVED TO FIGHT ON.

ACKNOWLEDGMENTS

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FOREWORD

by THE RIGHT HON. SIR ARCHIBALD SINCLAIR, M.P.
Secretary of State for Air

To those who seek to know what kind of men there are in the Royal Air Force, and what kind of work they do, I should like to recommend Mr. Narracott as a guide. His is a book for anyone who wants to be well informed about the manifold activities of the R.A.F. and its intricate organization without reading through a mass of specialized information.

Mr. Narracott gives the essential facts about a multitude of men and machines, from the fighter pilot to the men who sit in target boats waiting to be hit by a practice bomb, and from the latest and largest bombers to the power-driven sewing machines which mend barrage balloons. He describes the work of each Command, as well as the welfare organizations of the R.A.F., the W.A.A.F., the Empire Training Scheme, the Air Training Corps, the ferry pilots, and the Royal Observer Corps.

It is a large subject, ably compressed within the limits of a short book which deserves to be widely read.

Air Ministry, Whitehall, S.W.1
July 1941

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INTRODUCTION

THE science of aviation is so young that when the last war started it was still in the nursery. It had learned to toddle, but little more.

True, it had been born as long ago as 1903, when the American Wright Brothers got off the ground for the first time in a powered machine, but in the life of such a revolutionary new science eleven years is a very short time indeed. Flying had made fair progress in France, Britain, Germany and America and to a lesser extent in Russia and elsewhere, but in many countries it was almost ignored, while as a war weapon it was completely untried.

In 1914 aircraft were rickety contraptions of wires and struts, under-powered and not very stable. Comparatively little was known about aerodynamics, and what advance had been made was due as much to the unerring instinct of the pioneer designers as to any really extensive knowledge. In short, flying was still something of an experiment and was a risky business.

During the four years of war it grew from babyhood into lusty, menacing adolescence. It made sufficient advance to show that as a weapon of offence and defence it had come to stay. Although its strength was limited it proved that it could wield a not inconsiderable influence on the course of the war, and it did in fact do so. Thanks in no small degree to the efficient French engines, Allied

air power was on top at the start and for some time afterwards. Then followed two short periods when the introduction of the Fokker and the Albatross gave Germany the advantage, but still better types soon regained our superiority, and when the Armistice came the Allies were undisputed masters of the air and Britain was the strongest aviation Power in the world.

Great Britain's air force started life as an independent entity in May, 1913, under the title of the Royal Flying Corps, but no sooner was it in being than its two components, the naval and military sections, began to drift apart and come under the domination of the respective senior Services to which they were attached. A month before war broke out the naval section became known as the Royal Naval Air Service and its personnel donned naval uniforms and adopted naval ranks. The men of the R.F.C., who were to work with the land forces, were known by military ranks and wore the khaki of the Army.

In those early days aeroplanes were employed exclusively as "air eyes." They were in fact, fitted for nothing more than spotting for the artillery and doing short reconnaissances. Their limited range and complete absence of weapons of defence or offence prevented them from being used as combat machines. When air fighting started it was first conducted with rifles or revolvers carried by the pilot, and later, with a gun mounted on a device not unlike a motorcar spring. Later still aeroplanes were equipped with one or two guns firing forward through the propeller. Bombing for some time was conducted on equally elementary lines. The bombs were

either tipped over the side or dropped through a hatch in the floor of the fuselage.

As the war dragged on the strength of the opposing air forces increased, and there was an all-round improvement in materials, designs and technique. In April, 1918, the two British flying services were re-united under the present title of the Royal Air Force.

Considering the growing part which aviation had played in the war it is rather surprising that all the nations starved and neglected their air forces after hostilities had come to an end. It may have been—and most probably was—due to three things: firstly, to a weariness of war which inevitably follows a protracted national effort; secondly, to the resolve of the leading nations to settle disputes through the League of Nations instead of fighting over them; and thirdly, to the need for strict economy in national spending. The first and last (plus the Treaty of Versailles) were undoubtedly the reasons in the case of Germany and the other defeated nations.

But while air forces were whittled down civil aviation developed at an astounding rate all over the world. Increased range and improved performance of aircraft resulted in the starting up of air lines in most of the leading countries, some of them State-owned and most of them subsidized. Many fine long-distance flights, in which British designers, pilots and navigators played a prominent part, and a number of successful crossings of the Atlantic, pushed air transport ahead at a still faster speed, and gradually people forgot their earlier fears and travel by air became popular. Long before this war started most

of the civilized countries of the world had become "air-minded" to a greater or lesser degree.

As soon as Hitler came into power Germany began to build large fleets of ostensibly civilian machines. In the light of subsequent events few will doubt that they were designed largely with an eye to their use for war purposes, for many civil aircraft can easily be converted to military use. In the same way flying and glider clubs were also encouraged. Under a veil of secrecy Nazi Germany also commenced to build up a huge air force. The Junkers Ju 87B dive-bombers, which played such an important rôle in France and in the earlier attacks on this country, are relics of those clandestine activities.

Strange as it may seem at first glance, the Nazis' initiative in this direction may lose them the present struggle in the air. The Germans got ready for war so early that by the time it came many of their aircraft were obsolescent and some even obsolete. They were the last word in perfection at the time of the Spanish Civil War, but the useful life of the average aeroplane is not long, so that by 1939 some types had seen their best days. Much the same is true of Italy. She had prepared for the Abyssinian campaign and to aid General Franco in Spain, so that she was committed to certain types long before she crept into the war, and had insufficient time to change them.

On the other hand, Britain, with no aggressive intentions, did not start to build up her new air force until much later; almost, one might say, until after the crisis week of September, 1938. Wisely or unwisely, successive post-war governments had let our air strength fall nearly

to zero. Almost the only recruiting of pilots was done by means of what were known as short service commissions (four years on the active list and six years on the reserve, or *vice versa*). In 1925, however, the Auxiliary Air Force had been created, composed of part-time airmen who did their training in their leisure hours, chiefly at week-ends. This ensured a small reserve to be called upon in the event of war. The reserve strength was increased considerably by the formation of the R.A.F. Volunteer Reserve in 1937. These two were what the Territorial Army was to the Regular Army—a reservoir to be tapped in an emergency.

It was not until 1935 that the R.A.F. began to expand, and although Mr. Baldwin had told us that "our frontier is on the Rhine" and Mr. Churchill had cried in the wilderness (or, to be more exact, in Parliament), warning governments of Germany's mighty preparations, it was not until Mr Chamberlain had been to Munich that the force began to grow at any pace. That statement is apt to be misleading, for it takes a long time for schemes to produce results, and much useful spade work had been well and truly done by the Chamberlain Government and a lesser amount by the Baldwin administration.

By the outbreak of war the R.A.F. was a neat, compact, efficient little force, composed of first-class aircraft for all purposes. It had a thoroughly workmanlike organization and, as the results have shown, its training had been developed on sound lines. Its one inferiority to the *Luftwaffe* was in numbers, and now, thanks partly to American aid and partly to the herculean efforts of our own industry, that is being slowly but surely overcome.

The war in the Middle East and in Albania has shown men and machines of the Royal Air Force to be vastly superior to the *Regia Aeronautica* of Italy. Every week has made it more obvious that as an air Power Italy is not in the first class, despite all her pre-war boastings. Over Germany we have not the same marked degree of superiority. The German machines are better than those of their Axis partners and their airmen display more ability —or perhaps it is a greater determination to fight. The Italian flyers are not cowards, but many of them seem to have no heart for the struggle. Could the truth be known we should probably find that many of them would prefer to be fighting on the other side—or, better still, not fighting at all. It should be remembered that for not a few of them this is their third war in a very few years and they had had enough even before we started to trounce them. If Mussolini had not dragged them into it they would far sooner have stayed at home and cultivated their land or run their cafés.

And so it is against Germany that our chief struggle lies. There is no need to say that they are doughty opponents, for they have already shown that. Yet, in the summer of 1940, when the R.A.F. was relatively weak in numbers, the German Air Force was given one of the soundest thrashings imaginable. We had our losses, too, of course, but of the R.A.F.'s superiority there could be no doubt. We shall continue to have our ups and downs and, unless Hitler tries to invade us, the struggle may be long and dour, but there seems no reason to doubt the final result.

Perhaps a personal note may be excused. Since I returned from France, after the capitulation in June, 1940, I have been privileged to see something of the working of all the R.A.F. Commands. One could have no better tonic. Everywhere one sees signs of growing strength, of excellent morale among all ranks, and of a dogged determination to win the fight, however long it may last and whatever is in store.

Surely, with such a spirit, backed by the best of materials that money can buy and by the pick of the British Empire's manhood, we cannot fail.

A. H. NARRACOTT

LONDON, 1941

CHAPTER ONE

THE MACHINERY

THE Royal Air Force is controlled by a complicated machinery revolving around the Air Ministry. In his capacity as Marshal of the Royal Air Force and Air Commodore-in-Chief of the Auxiliary Air Force the King is at the head. Under him there is the Air Council, presided over by the Secretary of State or his deputy, and under that august body the various Commands of the Service proper. The Air Ministry itself is divided into many specialist departments too numerous to detail and almost too complicated to explain.

On the Service side the Commander-in-Chief is known as Chief of the Air Staff, an office occupied by Marshal of the Royal Air Force Sir Charles Frederick Algernon Portal, K.C.B., D.S.O., M.C., who succeeded Sir Cyril Newall towards the end of 1940, when the latter was appointed Governor-General of New Zealand. At home, the R.A.F. has eight Commands—Bomber, Fighter, Coastal (to which is attached a Marine Section), Technical Training, Flying Training, Maintenance, Balloon, and Army Cooperation. Each Command has its own Commander-in-Chief. There is also the Women's Auxiliary Air Force, which is performing valuable work.

Overseas, there are a number of other Commands

scattered around at strategic points so as to protect all parts of the far-flung Empire. They are: Middle East Command, with headquarters at Cairo; the Royal Air Force in Palestine and Trans-jordan, with headquarters at Jerusalem; the British Forces in Iraq (headquarters, Dhibban); R.A.F., India (headquarters, New Delhi); R.A.F., Mediterranean (headquarters, Malta); British Forces in Aden; and R.A.F., Far East (headquarters, Singapore). In addition, certain Empire countries have their own air forces.

The Canadian Air Force was started in 1916, when the War Office decided to establish in the Dominion an organization for training personnel for the R.F.C. In the early days of the 1914–18 war a large number of Canadians came to England to join the R.F.C. and the R.N.A.S. and as many as 800 officers and cadets had been enrolled in the Royal Flying Corps alone before the separate training organization was started up in Canada. On January 1, 1923, the Department of Militia and Defence, the Naval Service and the Air Board, which previously administered the Army, Navy and Air Force respectively, were amalgamated by the formation of a Department of National Defence. As a result, the Canadian Air Force, which had been on a semi-permanent basis, was abolished and a newly formed permanent force was granted the prefix "Royal" by H.M. the King.

Canada is also making other invaluable contributions to the war effort, notably the Empire Air Training Scheme, but that will be dealt with later.

Australia is another Dominion which has a most

efficient air arm of its own. The first air unit in Australia was formed in 1912, and the first complete Australian squadron left for Egypt in March, 1916, later playing an important part in the Palestine campaign. Three additional squadrons were organized for service in France, and early in 1918 the Australian Flying Corps established its own training wing in England. The strength of the Corps at the end of the war was over 250 pilots and a total personnel of between 3,000 and 4,000. Units of the Australian Flying Corps were responsible for the destruction of over 400 enemy aircraft between August, 1917, and the Armistice. In 1920 it was decided to form an Australian Air Force as part of the Commonwealth Military Forces, and on March 31, 1921, the Australian Air Force was formed by proclamation pending the passage of the Air Defence Act. On August 13, 1921, it became the Royal Australian Air Force. The Air Defence Act received Royal Assent on September 1, 1923, under which the R.A.A.F. became a separate service of the Defence Forces of the Commonwealth, with equal status to the Royal Australian Navy and the Commonwealth Military Forces. It is administered by an Air Board.

New Zealand also possesses a small but efficient air force. During the last war two flying schools trained pupils for the Imperial flying services, and over 300 New Zealanders served in the British flying forces. In 1923 the permanent air force was formed, under the title of New Zealand Air Force (Territorial), to cooperate with the Dominion's military forces. In 1937 the New Zealand Government undertook a general revision of defence

matters and a complete reorganization and development scheme for air defence was put in hand. The Royal New Zealand Air Force was granted permission to use the coveted prefix in 1934. It is now controlled by an Air Board, which administers the Regular Air Force, the Air Force Reserve and the Territorial Air Force.

Because of the brilliant part it has played in the hostilities in the Middle East the South African Air Force is fairly well known. The nucleus of a South African Aviation Corps was formed in 1914. The Corps was remobilized and sent to England in 1915 and became No. 26 (South African) Squadron, R.F.C. serving in German East Africa. Apart from this unit a great many South Africans came to England and joined the British flying Services. At the beginning of 1916 nearly 2,000 South Africans were under training in England and Egypt, and in all about 3,000 received commissions in the R.F.C., R.N.A.S. and R.A.F. during the war. In 1926 there was brought into being a general organization to put the Union Defence Forces on a stable footing. The South African Air Force was organized on the simplest basis possible, consisting of an aircraft depot, a flying training school and one composite active service squadron, an Active Citizens' Force and a Special Reserve for pilots and mechanics. By the middle of 1938 the S.A.A.F. had 200 first-line fighter and bomber aircraft and training machines, as well as civil aircraft capable of being converted into bombers. The Air Force is an arm of the South African Permanent Defence Forces and is administered by the Minister of Defence.

India, too, has a tiny air force, composed entirely of Indians, but this is in rather a different category, for it comes under the command of the A.O.C., R.A.F., India. It was formed in October, 1932.

This is by no means a complete picture of the air support which the Empire is giving to the Mother Country in this war. Men from almost every Dominion, Colony and other overseas possessions are to be found wearing the R.A.F. blue, and in the aggregate they make up a very considerable force.

Valuable help is also being given to the Royal Air Force by thousands of men from Allied countries which have been overrun by German aggression. The Poles, Dutch, Norwegians and Free French all have their own separate air forces operating within the framework of the R.A.F., while many Czechs and Belgians form part of the vast organization of the R.A.F. Volunteer Reserve. The United States of America is represented in the same force by the Eagle Squadron, while many lovers of democracy in other neutral countries are serving in various ways.

Thanks to the splendid organization of the Empire Air Training Scheme in Canada, Australia, South Africa and Southern Rhodesia the R.A.F. is assured of a continuous and increasing flow of recruits for all commands. To provide the airmen of tomorrow there is the Air Training Corps, formed in February, 1941, to provide pre-entry tuition for boys between the ages of 16 and 18, while for boys who are younger still (between 11 and 16), who are not old enough to participate in the A.T.C. scheme, the

Boy Scout Movement recently formed a new section, known as Air Scouts.

Though they do not form part of the R.A.F., no picture of the variety of organizations which are playing their part alongside the flying service would be complete without a passing reference to the Air Transport Auxiliary, a civilian organization which is doing valuable work in "ferrying" new aircraft from the factories and maintenance units to the squadrons and in flying American aircraft across the Atlantic; and the Royal Observer Corps, another civilian body, whose activities are an indispensable part of our defence against air attack. The anti-aircraft guns and searchlights come under the Army, but they, too, work in the closest contact with the R.A.F.; so does the Fleet Air Arm, controlled by H.M. Navy.

Two distinct Government Departments also work side by side with the Air Ministry. They are the Ministry of Aircraft Production, which supervises production not only in this country but in America and elsewhere, and the Ministry of Economic Warfare, which guides Bomber Command in the selection of suitable targets.

Most of these organizations will be dealt with more fully in later chapters, but they have been mentioned here in order to give some idea of the vast network which has united to help fight the enemy in the air.

CHAPTER TWO

GETTING READY

"I am convinced that the material we have today is fully worthy of the example handed down by the pilots and crews who so decisively won the Battle of Britain last September."

CAPTAIN H. H. BALFOUR, M.P.,
Under-Secretary of State for Air[1]

BECAUSE no man can take his place in the Royal Air Force, whether he is destined for service in the air or on the ground, until he has become thoroughly proficient, it might be appropriate to discuss the work of the training commands before dealing with the operational and other branches. The excellent way in which that training is carried out is shown by the high standard of fighter and bomber pilots, by the resource and skill of the crews of our giant machines, and by the efficiency with which British aircraft have been kept airworthy under the difficult and dangerous conditions of wartime.

Until recently there was only one Training Command in the R.A.F. but when the force began to expand at such an extraordinary rate it became obvious that there must be separate organizations to deal with flying and ground work. Flying Training Command and Technical

[1] After inspecting an R.A.F. Initial Training Wing on February 15th, 1941.

Training Command are now certainly among the largest in the whole wide range, and it is necessary that they should be, for an air force must work with one eye towards future requirements.

Flying Training Command is divided into six groups. One group looks after the initial training wings; two are responsible for elementary flying training schools and air observer-navigation schools; two control the Service flying training schools; and the sixth maintains the bombing and gunnery schools.

A pilot's tuition is really divided into four stages, though they are continuous. Whether he is a volunteer or a man called up under an age group any entrant attending the recruiting centre may express a preference for air crew duties. Subject to a satisfactory preliminary medical examination his papers are then marked provisionally for flying duties. The next stage is attendance before the Aviation Candidates Selection Board, who test him in mathematics and other subjects of importance to an airman and satisfy themselves that he is up to the required educational standards. He then has to pass the medical examination proper—and the physical standards required are high—before he is told to report at a receiving wing.

The young recruit is now ready to start his training. After receiving his uniform and kit he is taught how to salute, given lectures on Service discipline and etiquette, learns how to distinguish ranks, and, in short, is generally fitted for a career in the flying Service. After about a fortnight the recruit is transferred to one of the schools of an initial training wing, where elementary instruction

is given in mathematics, navigation, aircraft recognition, armaments and signals. At the same time he is drilled and sent on marches and runs, so that his physical and mental education progress side by side.

Candidates for flying duties are sometimes rejected on the ground that they do not reach the prescribed educational standards. Often they are hurt, and their friends are indignant. Does the R.A.F. want men or doesn't it? And what has education got to do with flying? Those are the sort of questions one hears occasionally. There are, however, very good reasons for laying down minimum educational qualifications for men who are to fly.

Pilots, for example, must write reports of their part in operations and they must be clear and free from ambiguity, for those reports are studied carefully, experience gained in actual operations sometimes determining changes in tactics or resulting in improvements in the aircraft employed. An airman cannot afford to be weak in mathematics, for navigation is essentially a mathematical subject. New instruments have been devised which make some of the processes automatic and cut out lengthy calculations, but even with such simplification one principle always holds good—that the navigator who readily understands what he is doing, and why, is better in an emergency than one who does everything by rule of thumb. And emergencies are bound to occur sometimes on active service.

Bomb aiming is another task for which a basic training in mathematics is invaluable. A bomb sight is a complicated instrument, requiring various adjustments to allow

for the type of bomb being used, for height and speed of the aircraft, and for wind direction and drift. There are two kinds of bomb-aimers—those who know exactly what they are doing and those who have merely learned a lot of meaningless rules. The first type of man sets his sight intelligently, because he realizes the factors for which he is making allowances, while the second type merely loosens a screw, rotates a dial and tightens another screw because he is told that he must do so, trusting to providence that all this weird magic will work. In an emergency there is no doubt which man would be the more likely to hit his target.

It is for all those reasons that the R.A.F. set out to discover, while he is at the first stage, whether a man has sufficient knowledge of the vital subjects to enable him to become a successful pilot, navigator, bomb-aimer or wireless operator-air gunner. There is a mid-course examination in mathematics, in which 60 per cent of marks must be obtained to qualify for completion of the course.

Throughout the long weeks at the I.T.W. he has not been in the air once and has probably not even seen an aeroplane at close range. Nevertheless he has had the sound grounding which will enable him to benefit by the slightly more advanced instruction he will receive at the next stage—the elementary flying training school. This is the really vital stage of his training. Though pupils are sometimes rejected even later, it is usually here that a man shows whether he is likely to make a good pilot or not. If an intending pilot fails at any stage of his training he

may be re-mustered for air crew duties or he may be given ground employment.

Almost as soon as he has settled into his new quarters the trainee receives his introduction to light aircraft, such as Tiger Moths or Miles Magisters. At first, of course, he flies dual with an instructor, but after a while comes the thrill of his first solo flight. By this time he has learned how to read his aircraft instruments and maps, has received further instruction in navigation, guns and bombs. During the whole of this course the pupil has little leisure time, nor wants any. He is much too absorbed in this exciting new life. If he is not in the lecture room he is out on the aerodrome, and by the time the day's work is finished he is quite ready for bed, for he will have to be up early.

Much of his most valuable flying experience is gained on the ground, thanks to an ingenious device known as the Link Trainer. It is a miniature aeroplane, complete with all the usual controls, and the pilot can guide it just as if he were actually flying. To master "blind flying" and navigation in the dark he flies with a wooden hood shutting him off from the outside room, so that he is forced to guide his "aircraft" safely by the use of his instruments. The Link Trainer is connected by an electrical device to an accurate little machine on the instructor's table, so that the expert can check the course the pupil is following. They can also speak to each other by wireless telephone, and so the trainee becomes accustomed to doing two jobs at once—flying the machine and keeping in touch with the ground.

Flying instructors have a tiring, trying occupation. They have no sooner moulded one lot of recruits and changed them, in a comparatively few weeks, into fairly competent fliers than they have to start the same course all over again. Yet they take a great pride in their work. The nation owes them a great debt of gratitude, for upon them rests the grave responsibility for the standard of the R.A.F. of tomorrow. They would far sooner be "having a go" at the enemy themselves, but they know that they are doing an invaluable job and they do it cheerfully and well.

By the time a man leaves the elementary flying training school he is quite at home in the air, though by no means ready to be pitted against the enemy. At the Service flying training school, if the embryo pilot is destined for fighter aircraft he concentrates on guns and flies in Harvards, Miles Masters or similar types; if he is to be a bomber pilot he trains on Avro Ansons or Airspeed Oxfords or Fairey Battles. The actual handling of the machine in daylight soon becomes almost automatic. The fighter pilot knows a great deal about evasive tactics and can do many hair-raising acrobatics, while the bomber pilot has little difficulty in appreciating the significance of each dial, switch and lever in his complicated cockpit. He is soon taking his machine on long flights, making his way by reading maps and by accurate navigation. The man who will one day be finding his way to Germany and back without much "outside" help is gradually taking shape.

When they are thoroughly competent in daylight flying pupils are initiated into the wonders of night flying. In

view of the great and still increasing importance of operations during darkness this is a vital part of his training. Handling an aeroplane in the dark is at one and the same time a great thrill and a searching test.

Accompanied by an instructor, the pupil struggles through the black-out to the waiting aeroplane, his parachute already in position. The engine has been started up, and when he sees the usual lamp signal telling him that the runway is clear he taxies to the starting point. Here, there is another exchange of signals before he opens up the throttle and roars down the lane between the dim landing lights. When the machine has got up sufficient speed he eases back the "stick" and in a moment the lights of the field are receding downwards and backwards. He is away. He gains height, turns gently and settles down to the thrill of night flying. The only lights visible are those on his instruments, and he must watch them carefully, for it is surprisingly easy to let one wing get low. He must also keep a look-out for other aircraft, for more than one pupil will be up at the same time.

Every now and then the instructor notes some small fault and gives the pupil some sound advice which is going to stand him in good stead when he starts operations. He is also keeping a sharp look-out. After a while the embryo pilot brings the machine back towards the airfield and circles above it. He flashes his code number and, having received permission to land, begins to lose height. This is the severest test of all. A night landing is not easy for beginners. Gradually he comes lower still, the landing lights seem to grow bigger and brighter, the

throttle is eased back and a slight jolting (sometimes a big jolting) tells the pilot that he is on the ground. He taxies back towards the hut and brings his charge to a standstill. A few moments later another pupil has taken his place.

At these Service training schools instruction is also given in bomb-aiming, and here again ingenious inventions enable much valuable experience to be gained on the ground. One of the best known aids is known as the bombing teacher. It is housed in a stone or wooden building about 20 feet or so in height. In the roof is a projector, which reproduces on the floor an aerial picture of a typical piece of English or German scenery. About half-way up is a platform, at the end of which is a bomb sight. The bomb-aimer lies prone on the floor and the pupil bomber pilot sits at his side, handling the controls which move the scenery in such a way that it corresponds to the movements of an aeroplane in flight.

Because the platform is necessarily stationary the floor scenery obligingly moves for the pupil at the same speed as it would appear to do if he were flying over it in a bomber. The bomb-aimer is told that the "aeroplane" is flying at, say, 10,000 feet and that there is a 20 m.p.h. wind blowing head-on. He then sets the bomb-sight accordingly and is given a target on the floor scenery to bomb. As the target moves towards them the bomb-aimer instructs the pilot as to course. "Left," he will say, and then, when they are travelling directly towards the objective, he will shout "Steady," take careful aim and pull the bomb lever. The scenery comes to a standstill in

the exact time that it would have taken a bomb to fall 10,000 feet, and a shadowy "X" marks the spot where the bomb would have hit. In this way the instructor is able to calculate exactly how accurate the aim has been. The bombing teacher is a wonderful invention and it has taught thousands of young R.A.F. men how to obtain a direct hit from a great height.

But it is by no means the only method of instruction. Another device is known as the Camera Obscura, and it is used in conjunction with aircraft. It consists of a wide-angle lens fitted into the roof of a small hut or tent, giving a clear view of the sky overhead. A picture of the expanse of sky is reflected on a piece of paper pinned to a table immediately below the opening of the lens. In this way one can look down at the paper and see the sky as clearly as if one were lying on one's back in a pleasant meadow on a sunny afternoon. The pupil bomb-aimer is sent up in an aeroplane fitted with a device which flashes a light as the bomb lever is pulled. As the 'plane speeds overhead a man in the hut under the lens plots its course with a pencil on the paper and when the light flashes in the aeroplane he marks the spot and calculates the margin of error, if any.

Yet another device for bombing instruction is the track recorder, also used in conjunction with an aeroplane fitted with a light connected to the bomb-lever. It is operated by two men and the course of the bomber is followed through two telescopes set at right-angles. As they turn handles to keep the aeroplane in their sight its course is recorded on a strip of paper, and when the light flashes

the spot is marked on the paper by an automatic pencil. The accuracy of the aim can then be computed by means of a scale which has already been worked out.

By the time he has finished the Service training course the pupil is a thoroughly trained man. He emerges from it proudly wearing on his breast his wings and on his arm his sergeant's stripes or the thin ring of the pilot officer. A percentage of the pupils are granted commissions. There is only one more stage left—the operational training unit, known as the O.T.U. Here, bomber pilots, navigators and wireless operator-air gunners are teamed up and they do much of their training as a crew. Once more they can gain valuable experience on the ground. Fighter pilots continue to receive individual instruction.

At these advanced schools there is invariably a room fitted up something like a lecture hall. Along one side are sound-proof cabins, rather like large telephone boxes, and in these crews are "sent on raids to Italy or Germany." The navigators plot their course and can obtain wireless information about their position from the instructor in charge of the class. From time to time aerial photographs of places on the route are flashed on a screen. Over "enemy territory" lights come up to indicate searchlights and flashes to appear like anti-aircraft fire, and such enemy activities have to be recorded by the wireless-operator in his log book.

After a few weeks of intensive training at this school the pilot is at last sufficiently skilled to go on active service, and he and the navigator and wireless operator-air gunner are posted to a squadron. Now for that "crack at the

Hun" for which they have been waiting so impatiently all these months!

The training at the air observer-navigation schools is equally thorough. When the course has been completed a pupil must be able to pin-point the position of his machine in all sorts of weather, by day or by night. He must have mastered the intricacies of aircraft radio; must be able to read maps, charts, compass and Aldis signal lamps; know how to fuse and drop bombs with precision; how to take air photographs, work guns and handle fire-fighting appliances. In short, he must be able to do every job in the aeroplane except fly it. Navigation is of paramount importance, for upon the accuracy with which the proper course is followed depend the lives of the crew and the safety of a valuable aeroplane.

The navigators and the wireless operator-air gunners both attend the bombing and gunnery school, where they learn how to handle such guns as the Vickers, Browning and Lewis, and practice with ciné-guns and camera-guns. Some of the firing is done on ground ranges and some in the air at drogues towed by aircraft. The wireless operator-air gunner must become expert in the sending and receiving of Morse messages, and he also receives a thorough grounding in magnetism and electricity, in radio repairs, and in keeping a log. When he gets to the operational training unit he is given instruction in a cabin which tilts every time he stretches out a hand to adjust a knob on his set. In that way he becomes accustomed to manipulating a radio set while an aeroplane is bumping about in rough weather.

This gives some idea—though by no means a complete picture—of how the R.A.F. trains its recruits for the air. The whole range of ground and air training is controlled by an Air Member, Air Vice-Marshal Garrod. Under him, are Air Commodore A. J. Capel, D.S.O., D.F.C., who is Director of Operational Training; Air Commodore A. H. Orlebar, A.F.C., Director of Flying Training; and Group Captain M. Thomas, Director of Technical Training. Air Commodore Orlebar will be remembered for the prominent part played in Britain's success in the Schneider Trophy races. After the 1929 contest he set up the world's speed record of 357.7 m.p.h. in a Supermarine Rolls-Royce S.6.

Technical training is even more complex than that for flying duties, for it embraces so many subjects. Many thousands of young men are constantly going through the Command's hands, and when they have concluded the course they are skilled or semi-silled craftsmen. Technical Training Command is sub-divided into three groups. Two are responsible for general training, and the other is confined entirely to the allied subjects connected with signals, such as all forms of ground wireless, teleprinters and telephones. Throughout the country there are a number of schools, which are rather more like vast camps, covering many acres of ground.

Men embarking on a technical training go straight from civilian life to the receiving wing of a recruiting centre, where a Trade Selection Board decides for which calling his qualifications make each man best suited. For a week or so his life is very much like that of the new recruit for

flying duties, for he is supplied with uniform and kit, does a great deal of drill, learns Service discipline, and so on, and at the end of this time he is drafted to a school to learn his appointed trade. The duration of the course depends on the trade. When this has been completed the most successful pupils go for a short period to a squadron and then come back to a training centre to qualify for a more responsible post.

The vast majority of young men are trained as flight riggers and flight mechanics. These are the engine and airframe fitters. But in addition there is an almost bewildering variety of trades, such as lorry driver, motor-transport mechanic, fitter driver (who can overhaul vehicles), fitter-armourer (for both bombs and guns), motor-cyclist, motor mechanic, machine-tool setter and operator (including turners, grinders and millers), blacksmith, acetylene welder, coppersmith, sheet-metal worker, instrument repairer, fabric worker, parachute packer, aero-carpenter, batman, mess waiter, cook and butcher, photographer (developers, printers, enlargers and processers), police, fire-fighter and physical training instructor. This is not a comprehensive list, but it is enough to show the vast variety of jobs for which men must be trained if an air force is to operate successfully.

In civil life many of the physical training instructors are professional boxers, cricketers and footballers. At one time one R.A.F. training establishment had under instruction a football "team" whose combined transfer fees amounted to £150,000. The same station could put into the field a cricket eleven composed almost entirely of men

who have played for England. There were also several boxers of international repute.

The training establishments are all well fitted up, possessing a cinema, concert hall, gymnasium and swimming bath. Though they work hard the pupils enjoy their life here, for there are first-class facilities for sport and recreation, the food is good, and there is enjoyable companionship. They are taught intelligently, without any of the bad old "sergeant-major" stuff, and by the time that they have finished the course they have the comforting assurance of having mastered a skilled or semi-skilled trade which, should the war end on the morrow, would be of value to them in civilian life.

CHAPTER THREE

THE STRIKING FORCE

"Already people are almost surprised if such (bombing) visits by the English have for once not taken place and they make guesses as to why the night was quiet."

Deutsche Allgemeine Zeitung, July 14, 1940

BECAUSE it is the force upon which we must ultimately depend to batter Germany to her knees, Bomber Command is perhaps the most important branch of the Royal Air Force. Though our fighter aircraft protect us by warding off the enemy's blows and destroying the bombers he sends against us by day or by night, they cannot give us victory, which is something which can only be won by constant and unremitting attack.

It is to Bomber Command that we look to destroy Germany's war industries, its fuel and oil supplies, its communications, ports, bases and aerodromes. And we do not look in vain. Shortly before the outbreak of war Göring boasted: "I have convinced myself personally of the measures taken to protect the Ruhr against air attack. We will not expose the Ruhr to a single bomb dropped by enemy aircraft." Not one bomb, but thousands of bombs, have been dropped by our bombers in more than five hundred raids on the industrial Ruhr since those vainglorious words were uttered.

Even that represents only a small proportion of the activities of the R.A.F. over Germany. Statistics prepared by the Air Ministry and the Ministry of Information show that from the beginning of the war up to the start of 1941 the number of target area attacks made against Germany alone was over 1,400. More significant still, during the three months October to December, 1940, the number of raids which our aircraft made on Germany was more than half the number made in the whole of the preceding thirteen months of the war. This was achieved in the unfavourable weather conditions of winter and it is a clear and heartening indication of our increased and increasing striking power in the air. In addition to the attacks on Germany itself, of course, Bomber Command has shared with Coastal Command the hundreds and hundreds of raids on the invasion ports and on enemy sea and land bases and other military objectives in all the occupied territories, as well as assisting Greece and making direct attacks on Italy.

The bombing of Germany (and Italy) is all part of a master plan prepared long ago—probably even before the war—in consultation with scientists, economists, and industrialists and with the Ministry of Economic Warfare. That plan is to strike the enemy at his weakest points, so that every bomb achieves its maximum effect in reducing his resistance. In other words, the policy of the R.A.F. to-day is the same as it was towards the close of the last war, when Viscount Trenchard was in charge—to "hit the Germans in Germany." As Sir Archibald Sinclair said in his speech to the English-Speaking Union

on February 25, 1941, "We grudge every bomb dropped on a French, Belgian, Dutch, or Norwegian port; we give them only what is necessary for our safety and keep the rest for the Germans in Germany. We hate the cruelty of these bombardments. We never wanted war, with all its horror and destruction, but the Nazis brought it on the world. They spared no horror to Coventry or London —and we must 'be copy now to men of grosser blood and teach them how to war.' "

There was—and is—no room in the British plan for the German practice of indiscriminate "terror" bombing of civilian populations; for though it may be some consolation to the bombed inhabitants of our own cities, towns, and villages to know that we were doing the same sort of thing to non-combatants in Germany, it would have no real damaging effect on Germany's war effort. The British people can take heart from the solemn pledge given by the Secretary of State for Air:

"Our blows will fall faster and harder on the enemy—and don't imagine that they are soft now."

The new range of heavy bombers which have gone into production during 1941—the four-engined Short Stirling, the Halifax, and the Avro Manchester—will be able to do much to carry out that promise. Their range will enable them to reach parts of Germany which have known little about the horrors of bombing, while the increased speeds of our bombers will allow them to bomb Germany and get home again even during the short nights.

Some people may be inclined to wonder how it is that

the R.A.F. are able to do greater military damage than the *Luftwaffe* despite the fact that possession of numerous aerodromes in France and other occupied countries means that the German bombers can get here in a third of the time and with correspondingly less risk from weather and defences. There are a number of reasons. One is this: The Germans have always been a military-minded people and one can see it in their conception of the function of an air force. They always visualized it first and foremost as an adjunct to their Army. Right from the start, Nazi airmen had been trained for Army co-operation work; they were to be employed in close support of land operations. One saw their technique in Poland, Holland, Belgium, France, Yugoslavia and Greece. As long as they were acting as a sort of air artillery, blasting a way for their advancing troops, they were extremely successful. But when the Continental campaigns came to an end they were forced to act against this country on their own; to engage in long-range bombing for which they had not been trained. When our fighters made their losses too great in daylight the Germans were forced to switch over to night operations, and this was another thing for which they had not been trained. It was, in fact, something for which their chiefs had always professed great disdain.

On the other hand the R.A.F. had always been used as an independent force. The pilots and crews were trained for long-distance flights and they had learned how to operate in the dark as part of their normal training. The Germans are now laboriously converting their air

force to the new technique, but it is a long job. First of all they have had to train some of their most adaptable pilots and crews to find their way to distant targets and then they had to get them used to operating at night.

Another reason for the superiority of our bomber crews in night and long-range operations is that many of them got excellent practice during the early part of the war through the medium of leaflet raids. By the time they were called upon to carry bombs instead of bundles of paper not a few of our pilots and navigators knew their way to many important targets in Germany. There is still another reason. Every raid carried out in Germany is prepared with the utmost care. As soon as the target for a particular night is known, all the available data about it is obtained and studied. Maps, diagrams and photographs are fetched out, and before the bombers start out each navigator is given a chart showing all the smallest details about the factory, power station, railway or aerodrome which is to be bombed.

A few hours before they take off, every pilot, navigator and wireless operator-air gunner who is to be engaged in the raid attends what is known as a "briefing." This takes place in a room on the aerodrome, rather like a lecture hall. Nearly always there is a white screen, similar to those used in cinemas, and a projector, as well as a blackboard. Each navigator as he enters is handed a chart, showing him the contours of the country in the area of the target, together with a detailed plan of the objective itself. As the station commander and the intelligence officer give them a good deal of useful information about

reaching their target and the site they are to attack the crews listen intently and make notes. Photographs and plans of the target are shown on the screen while the intelligence officer points out the vulnerable spots to be bombed. Strongly defended areas *en route* are also enumerated, as are the location of balloon barrages.

It is an interesting experience to attend one of these strange gatherings. The crews lounge in easy chairs, smoking a pipe or cigarette, and they seem as unconcerned as though they were being instructed about a perfectly safe training manœuvre. Sometimes they ask questions and the photographs or charts are flashed on the screen two or three times to clear up some small doubt. When every man is clear about what he has to do and how he is to do it the station commander tells them the take-off time and the precise minute by which they must be starting back if they are to be home before dawn.

Then the airmen go off to their own room, where each crew works separately, for once off the ground they know that they may not see the other aircraft engaged on the raid until they are safely back home again. Pilots and navigators discuss and plot their course so as to make use of distinctive or well-known landmarks, such as railways, *Autobahnen*, canals, rivers and lakes, and the navigator gets busy with dividers, parallels and scales, deciding the details of the route. After a good meal they are off. In the gathering dusk the crews are taken out in vans and lorries to the bombers waiting deployed on the airfield, there is the whirl of the powerful engines starting

up, and then, one after another, they rumble across the landing field and become swallowed up in the darkness of the distance.

There is something unreal about waiting on a bomber station while the machines are "away on a job." Inside the operations room there is an air of expectancy. The wireless operators, in the adjoining room, are making queer whistling sounds on their receiving sets as they listen for messages from the aircraft which are speeding onward somewhere in the darkness outside. On a blackboard occupying most of one wall the names of the crews and the call signs of the respective machines are chalked up, and against each bomber's number is the time at which it took off.

In the small hours of the morning, after waiting what seems an age, one sees a messenger hurrying from the wireless room bearing a slip of paper. One of the operators has picked up a message from a member of the squadron announcing that it has bombed the target. An entry is made on the blackboard, giving the time. At intervals similar messages come through. Occasionally the message is that the bomber has been unable to locate its primary target and is going on to an alternative one. If it fails at that there is still what is known as a "last resort" target.

At intervals throughout the night messages continue to arrive, and then there is a break until the bombers' operators commence to send through Morse requests for a "fix" (a location point), and just as surely as though they had been taken by the hand and led, the crews and their giant machines are guided back home. Just before dawn

those waiting patiently in the operations room can hear the drone of the powerful engines of the Wellingtons, Whitleys, Stirlings, Hampdens or some other type. They do not usually come back together. There may be quite long intervals between them, for they have not all followed the same route.

Each machine requests permission to land and, having obtained it, circles around and comes floating down like some giant bird. Not long after, the pilots and navigators come into the "ops." room, usually puffing the first cigarette which they have been able to have since they took off. They look tired and travel-stained after having been in the air for anything up to eight or even ten hours, but they still have their reports to make. Now starts the friendly but very thorough "third degree" by the intelligence officer, on which the success or failure of the raid will be decided. The men describe not only where their bombs fell and the effect they had, but they tell of things they saw on the long journeys out and back. Sometimes they report having encountered an enemy fighter, sighted a suspicious-looking ship or seen some new lights, but more often there is nothing to record except the actual bombing operations.

When they have given the intelligence officer the best picture they can of their part in the attack the pilots and navigators go off to get a well-earned wash, breakfast and sleep. Each crew in turn tells in unexaggerated fashion what was seen and done, and when all have told their modest, matter-of-fact tale, the intelligence officer has a comprehensive picture of the operation. He sifts the

information thoroughly and on it prepares his report for the Air Ministry.

For the bomber crews, raids on enemy territory are divided into two distinct phases—tedious, long and tiring journeys and short periods of feverish activity over the target area. When they go out to take off they are warmly wrapped up, for even on nights when it is really warm on the ground it can be bitterly cold at 20,000 feet. Perhaps the most exacting job is that of the rear gunner, familiarly referred to in the R.A.F. as "Tail End Charlie." He sits in his enclosed turret right at the other end of the fuselage from his companions, and there he must remain all through the flight. His duties are to ward off attack by fighters and to observe the effect of his bomb-aimer's missiles. There is another gunner in the nose of the machine.

Once on a straight course the pilot can turn a switch and leave the guiding of his machine to the automatic pilot, which the R.A.F. man, with his love for a nickname, always refers to as "George." This clever device enables the machine to fly straight on, compensating for the effects of wind. It is a great boon on these long night flights. The wireless operator has plenty to do on both outward and homeward journey. He is the navigator's "right-hand man." The navigator himself is the busiest member of the crew, for he has constantly to watch that the machine is on the right course. He must never be "a stranger in these parts."

On the outward journey the bomb-aimer makes the necessary calculations for wind-drift and other factors,

and sets his bomb-sight as he has been taught during training. Approaching the target he instructs the pilot as to minor alterations of course. Then, as the target looms near, he squints along his sights and pulls the lever. After the familiar cry of "bombs off" there follows an anxious few moments while the missile hurtles downwards, to be succeeded by the blinding flash of the explosion. During the whole of this time the enemy's ground defences are sure to be busy, and newcomers to operations get the horrible impression that every gun is ignoring the other British bombers and concentrating on his machine. Once the bombs have been disposed of and the necessity for a steady platform has ended, the pilot begins to take violent evasive action. Safely out of the range of the guns the wireless operator tells the home station that the task has been carried out, and then starts the long, exacting journey back.

Sometimes our giant machines have stood up to terrible poundings and yet got home safely. It is a tribute both to the skill and endurance of the crews and to the high standard of British workmanship. There are times when electric storms make crazy patterns of sparks from the ends of the guns and other metal surfaces. There are nights when gales buffet men and machines cruelly. Yet the crews of Bomber Command take all this as merely part of the job. Probably all that the world will hear of their activities on the morrow is that "Aircraft of Bomber Command last night bombed the docks at Kiel, the oil plant at Stettin," or something equally brief. But the men who have risked danger and suffered discomfort are

content—content in the knowledge that the task which was entrusted to them has been well and truly carried out.

But bombing is not the only activity of this great Command. One section is engaged on the strenuous and hazardous task of laying mines in enemy waters, particularly in the Baltic. This is work calling not only for great coolness and endurance, but high navigational skill and accuracy. Since the start of the Norwegian campaign the R.A.F. have mined so successfully all the areas from the farthest eastern German Baltic ports to as far north as Norway that there is no safe channel for enemy shipping and no German-occupied fjord, estuary or harbour which can be used with safety.

A number of German ships are known to have been sunk by this means, and the operations have become so successful that Germany is forced to maintain in the Baltic a large fleet of observation ships, searchlight platforms, balloons and *Flak* (anti-aircraft) ships, while a proportion of her mine-sweepers, which she can ill afford to spare, has to spend its whole time sweeping the seas. As fast as they are removed, R.A.F. Bomber Command Hampdens or other mine-laying aircraft go out and replace them, and they are constantly creating new "fields." Great care is taken to ensure that the mines are dropped in the right place. Often the aircraft circle around for a long time to make certain that they are over the exact spot where they have been instructed to drop their cargo. The machines must come down to a fairly low height to ensure accuracy of aim, and then, with para-

chutes to carry them down gently, the mines are "sown" and the fields built up.

This work must necessarily be done at night. On the way home the crews are sometimes allowed to seek a little diversion from the monotony of this tedious and exacting work, and occasionally they are able to report a successful attack on an enemy ship or on a land target. More than one of these mine-laying aircraft has had a winning fight with a German night fighter and sent it crashing into the sea.

In considering the work of an air force one is apt to think only of the achievements in the air, forgetting that for every member of a flying crew there must be between thirty and forty men on the ground. Without their ground crews bomber squadrons—and fighter squadrons, too—would be lost and would have to cease operations after a very short time. Every time that a bomber completes a successful raid it is, indirectly, a tribute to the efficiency of the maintenance staffs—the men whose unexciting task it is to keep the machines airworthy. Upon the standard of their work depends the safety not only of the valuable aircraft but of the crews of five or more; it is a great responsibility.

The maintenance men take a great pride in their work and a personal interest in the particular aeroplane for which they are responsible. They will even speak of it as "my Wellington" or "my Whitley," and if it has done well on a raid they will glow with pride and be as pleased as if they had taken part in the raid themselves. The pilots and flying crews trust these men implicitly, for

they know from experience that it would be regarded as base treachery to give what is tantamount to a certificate of airworthiness for a machine which was faulty in the smallest respect. Long experience of working together has created between the men on the ground and the men who fly a very real understanding and friendship. The maintenance men are the technical experts, and often their advice is sought about such things as minimum safety margin for fuel loads (enabling a maximum bomb load to be carried) and other knotty problems on which the fliers' lives may well depend.

When a bomber is going on a raid the ground crew stay with it until it takes off and wait to take it over on its return. As soon as it has landed, the fitters, riggers, armourers, electricians and instrument experts go over it thoroughly and get it ready for the next "outing." The speed at which these men work is almost incredible. After a raid on Germany a bomber returned to its station at 3.30 a.m. It had to undergo one of the thorough inspections made at the end of every 30 hours' flying time and it had to be re-doped—that is to say, have all its exterior surfaces sprayed. Six hours later it was ready. Another machine had been fairly badly damaged in a night raid, but at ten o'clock the following morning, when an officer came from group headquarters to examine it, everything had been put right and the bomber—a Whitley—was all set for the next raid.

Whether it has been hit or not, every bombing aircraft has an inspection after thirty flying hours, and each overhaul becomes progressively more severe and extensive up

to one hundred and twenty hours, when the process starts all over again.

In wartime the maintenance crews have to work under pretty bad conditions. It is not safe to leave aircraft in hangars, because of enemy attacks, and so they are deployed on the airfield. The ground men, therefore, have to work in the open in all weathers. Each heavy machine needs a team of twelve to keep it in trim. A corporal, two fitters and two riggers do all of what may be called the running repairs. Then there are the armourers, whose task it is to "bomb up" and feed ammunition into the guns. The filling of the fuel tanks alone is no small task. For every hour in the air a heavy bomber, such as a Wellington or Whitley, requires between 80 and 90 gallons of petrol. It is not uncommon for these giant machines to make flights of eight hours, so that something like 700 gallons of fuel have to be loaded on to each aircraft. Petrol weighs round about $7\frac{1}{2}$ lb. a gallon, so that a total weight of over 5,000 lb. has to be shifted before a single bomber can start out on a raid. And on top of that there is oil to be thought of; tons of bombs have to be loaded into the racks; as well as flares, pyrotechnics and a host of other things. This gives some (though an inadequate) idea of what work is entailed in the operation of a heavy bomber squadron.

Fully loaded, a typical British heavy bomber aircraft, the Whitley, weighs between 12 and 14 tons. Yet, like all the smaller machines, it has its beginning in thousands of small parts, many of them not so big as the palm of one's hand. There is something truly romantic

about seeing these giants take shape. One can walk in at one end of a factory, watch girls stamping out little bits of aluminium alloy; go on to another great hall where the fuselages are being assembled on steel jigs; travel on again and see detachable parts of the wings, tail units and wing spars being prepared; watch men juggling with seemingly endless and inextricable tangles of wires and electrical fittings, women working at fabric coverings, men spraying the airframes and others fitting engines; and finally, after what seems like a route march, emerge on to the testing ground to see a finished bomber being put through its paces.

All those little bits and pieces have somehow been moulded together into a monster which is nearly 70 feet long, has a wing span of 84 feet, can rise to a height of about 5 miles and can carry five men for a distance of about 2,000 miles at a cruising speed of considerably over 200 miles an hour.

It is an experience which is rather apt to take one's breath away and leave one with a sense of unreality.

CHAPTER FOUR

FIGHTERS AT WORK

"Never in the field of human conflict was so much owed by so many to so few."

MR. CHURCHILL, House of Commons, August 20, 1940

THIS memorable phrase of the Prime Minister's sums up the great debt which all of us owe to the brilliant young fighters who fly the Hurricanes, Defiants, Spitfires and even newer aircraft which are now being turned out. Few will doubt that in the summer of 1940, and particularly in those dreadful months following the French capitulation, it was the men of the R.A.F. Fighter Command who saved this country from annihilation and probaby also from the horror of a German invasion.

Nobody who was living in South-East England at that time is ever likely to forget how these men went into action day after day against enemy forces which were invariably much stronger than their own, nor are they likely to forget the unfailing regularity with which the invaders were split up into straggling formations, turned from their would-be targets and sent scurrying for home. Day after day and week after week the scale of the air fighting went up and up in a terrifying crescendo, and yet always the small band of British fighter pilots and their first-class machines proved equal to the task.

In the middle of July German losses were at the rate of about a dozen a day. A few days before the end of that month 20 raiders were destroyed in 30 minutes. Early in August 120 enemy bombers and fighters were shot down in less than 48 hours. During the whole of the time the British pilots exacted a steady toll of about 12½ per cent of the enemy's forces, so that the more Göring sent over the more he lost. By the second week of August the enemy casualties had begun to mount to more than 50 a day and the German Official News Agency admitted that the raids entailed "great sacrifices." On September 7 the Nazi loss went up to three figures, and then, on that memorable Sunday, September 15, R.A.F. fighters accounted for the record number of 185. It was the fourth time in five weeks that more than 100 German aeroplanes were left scattered over the fields of Kent and the neighbouring counties after a day of almost non-top fighting. It was the climax to four days of terrible encounters in which the *Luftwaffe* sacrificed 620 aircraft and approximately 1,550 trained men. The corresponding British loss was 105 aircraft and only 55 pilots.

These blows knocked the heart out of the German Air Force, and although they still continued to come over it was in considerably reduced numbers. At first, the Germans must have thought that their daylight losses in attacks on this country were too bad to be true, for they kept pegging away with large bomber formations against our channel shipping, coastal areas and aerodromes. Then they sent stronger fighter escorts, as many as five Messerschmitts to each bomber; later, they switched over

to scattered night raiding, then to mass night attacks on London, employing converted Messerschmitts as fighter-bombers for "tip and run" daylight sorties, hopping in and out of clouds to get what cover they could before unleashing their small loads of bombs and scurrying back home.

Since that time the main German attack has been carried out during darkness, day raids being made only when cloud offered sufficient hiding places from the deadly fire of our fighters. The full story of that huge-scale air fighting of 1940 has been told in the pamphlet, *The Battle of Britain, August–October, 1940*, issued by the Ministry of Information on behalf of the Air Ministry. The deeds recounted there must have thrilled every British man and woman, and they deserve to rank with the great land and sea victories of the past. Perhaps the world will never again see air combat on such a scale, for the R.A.F., ably assisted by the anti-aircraft guns, taught the Germans the severe lesson of how expensive in men and machines it can be to attack a well-defended country in daylight.

During that memorable period, when the eyes of the world were focused on Britain, pilots of Fighter Command definitely shot down 2,375 German aircraft and almost certainly destroyed many more, while the cost to themselves was 375 pilots killed and 358 wounded. In terms of trained men the loss to Germany was probably about 6,000.

Since those days even faster and better fighter aircraft have been produced. We now have in service the Typhoon,

the twin-engined Beaufighter, the Whirlwind and the Tornado, while others are on their way. The earlier Hurricanes and Spitfires have been replaced by faster and even more efficient versions, some equipped with cannon, while new machines, Americans among them, have gradually come into service; but it was the Mark 1 Spitfires and Hurricanes which bore the brunt of the Battle of Britain and the Battle of London. Sir Archibald Sinclair summed up the position when he said: "The decision to adopt the eight-gun fighter, like the Hurricane and the Spitfire, may well rank as one of the great decisions in the history of the war."

Both machines were "born" more than five years ago and it came about in this way: An R.A.F. specialist visited an aircraft factory to discuss a secret specification drawn up by the Air Staff for a new type of single-seat fighter. It called for a speed and armament greatly in excess of anything then known. Six, or even eight, guns were the aim, with a speed of about 350 m.p.h. It was to be a reply to the hordes of new fast bombers which Germany was known to be producing for her second attempt at world domination. To get this projected new design on the drawing board, and then to make and fly it, would necessarily take many weary months; it would be at least a year before even the prototype could be produced. Meanwhile Britain's existing fighters were actually slower than the new German bombers already in production—a grave situation indeed.

At the works the R.A.F. officer was shown a high-speed monoplane, developed and built as a private venture by

the firm, the Supermarine Aviation Works (Vickers), as it was then. It was planned for only four guns and had a lower performance than that called for by the new specification, but it had all the makings of a first-class fighter. If it could be modified it would save precious months and even a couple of years. The problem was worked out in consultation with the famous designer, R. J. Mitchell, who died more than three years ago. Yes, said Mitchell, it could be done. The officer returned to the Air Ministry to urge that the modification should be made and the new aircraft adopted. Thus the famous Spitfire was brought into being.

Simultaneously with the development of the Spitfire the firm of Hawkers had been asked to produce a fighter to the same specifications. That fighter won fame as the Hurricane. Here again, there was close collaboration between the Air Ministry and the industry. A privately produced machine, the four-gun Hawker Fury, was taken as the basic design. The armament was doubled and changed to wing position, a more powerful engine was specified, and other modifications were made. To Mr. Sydney Camm, chief designer of Hawkers, goes much of the credit for a most successful job.

Those fighter aircraft proved themselves superior to anything the Germans could produce in 1940 and there seems no reason to suppose that their successors will not again beat back the Nazi menace; but while giving all due credit to the machines one should not forget the men who fly them and the ground crews who keep them in the air.

Fighter pilots all seem to be two people—one person in

the air and quite another one on the ground. Talking to them on their aerodromes, in the mess or in the wooden huts where they wait for the call to action, it is extremely difficult to realize that these quiet, modest, youthful-looking boys are the demons of the air who have taken—and are still taking—such a deadly toll of Göring's and Mussolini's men and machines. Many of them are shy of strangers and all of them hate even the slightest suggestion of boastfulness. They call self-praise "shooting a line."

At the start of the war the R.A.F. Fighter Command pilots were nearly all young men who had joined because flying had "got into their blood." It was a great thrill and a glorious adventure to go hurtling through the air at a speed which, only a few years before, had been regarded as impossible. But after a while anyone who was in constant touch with them began to notice a subtle change in their outlook. At first it was difficult to understand. It was not just that they had been under fire and had seen enemies going down before their guns; it went much deeper than that. The pilots never talked about it; probably they did not even notice that their attitude had changed; but gradually, by a chance remark heard in the mess or a casual sentence uttered on the aerodrome, the answer came out.

These young men, whose sporting instinct and breeding would prevent them from doing a dirty thing, had perhaps seen a German aircraft bombing or machine-gunning helpless French or Belgian women and children as, terror-stricken, they stampeded along the roads which would lead them to safety from the advancing German

Army; or they had been at Dunkirk, when they had seen cowardly attacks on unarmed men as they stood patiently on the beach, as they waded out to the waiting motor launches, or as they sat, wet through, in the tiny boats. This was not war as they understood it, it was cold-blooded, calculated murder. And then, after the attacks on England had got going, they saw the ruined remains of poor folks' homes or perhaps even saw the bodies of the victims; they read of attacks on lifeboats, on light-ships and other people engaged on humanitarian work.

From that time onwards their impersonal attitude towards air fighting underwent a complete change, and instead of those gallant young adventurers of the air German airmen encountered cold-eyed, deadly opponents, determined at whatever cost to destroy them.

The fighter pilot's life is very different from that of his colleague in a bomber squadron. Like Mr Micawber, he spends a great deal of his time waiting for something to turn up. If he is on day operations he is up before dawn and before most of the outside world is awake he is standing ready in a wooden building known as the dispersal hut, warmly wrapped up in his flying kit and with his life-belt (known as a "Mae West") fitting snugly round his shoulders. He may spend the whole of his "instantaneous call" time hanging about or he may be in action from the first minute onwards.

On an R.A.F. fighter station duties are so arranged that one section of the pilots and machines are ready to take off at a minute's notice while the others are on reserve. The dispersal huts are connected by telephone to the

operations room, and so to Fighter Command, and as soon as the presence of enemy aircraft approaching or over British soil is signalled the pilots standing at the ready dash out to their machines, the engines of which have aready been started up, and take off to attack. Thanks to their radio-telephone they can talk to each other in the air or can communicate with their home station, and in this way they receive the latest information as to the position of the invading aircraft.

As soon as their quarry is sighted the flight or squadron commander gives instructions over the R/T and the R.A.F. fighters zoom into the fight. The actual guiding of the machine is automatic to these highly trained men and they concentrate on getting the emeny into their sights. As the bomber or fighter appears straight ahead they press a single button which sets in motion all their eight guns or their cannon, spurting bullets or shells at a terrible rate. So concentrated is the fire that the bullets cut into the metal rather like a circular saw. As soon as the ammunition is getting exhausted or the fuel supply is running low the fighters hurry back to their base, and in an incredibly short space of time their guns are recharged and their tanks replenished and they are back into the fray again.

When their period of "immediate call" is up the pilots go into reserve, which means that they must be ready to take off inside thirty minutes after receiving a summons. They are always ready well before this, however, and regard it as a "poor show" if they are not in the air in a quarter of an hour.

The machinery by which the approach of enemy aircraft is detected is well known, but it is worthy of repetition. The raiders are either seen or heard by the observer post crews, who immediately notify their centre. Centre warns simultaneously the group centre of R.A.F. Fighter Command and the anti-aircraft batteries, so that while the guns are waiting to go into action fighter aircraft standing at the "ready" take off to tackle the intruders. The operations control, though it may seem somewhat complicated, is actually so flexible that it can be changed without confusion or delay to meet each new situation as it arises. No greater test of its flexibility or effectiveness could have been provided than by the large-scale daylight fighting of the summer and autumn of 1940, but it worked then with machine-like precision.

A great proportion of our fighters are now equipped with cannon. The advantage of the cannon over the machine-gun is that it has a much greater range and more damaging power. The British guns are a much improved version of the Hispano-Suiza *moteur-canon*, and they have proved a complete success, vastly superior to the mass-produced *Rheinmetall-Borsig* gun used by the Germans.

One of the most obstinate problems of the war—and it is common to both sides—is that of finding and destroying the night bomber. We have our searchlights and our anti-aircraft guns, of course, but while these have had their successes they cannot offer a lasting solution to the problem. The real answer lies in the night fighter, and so the R.A.F. has set aside a proportion of its fighter pilots and equipped special aircraft for night operations. At first

these had a thankless and almost impossible task, for searching for a fast-moving bomber in the darkness can be likened to trying to find a black dog in a blacked-out cellar. New material and new technique, however, are gradually bringing success, and the time may come when enemy bombers will find it almost as dangerous to operate over this country at night as they have done in daylight.

In recent months the activities of our night fighters have been extended. As new and longer-range types of aircraft become available Fighter Command was able to extend the patrols to cover the enemy aerodromes in German-occupied territory. This tactic has had no little effect on the German night bombing operations, for the enemy crews know that though they may have carried out their bombing raid and be back over "friendly" territory they are in danger of attack at all times. The appearance of lights on the aerodrome to assist them in take-off or landing may result in a bombing or machine-gun attack, while they may be set upon over the Channel and shot down before they can put up any defence. This extension of our fighter activities is also employed at daytime, and the offensive patrols carried out by bombers and their Spitfire or Hurricane escorts have brought a number of satisfactory results.

Fighter Command has as its commander-in-chief Air Chief Marshal Sholto Douglas. In appearance he has much in common with the chief of Bomber Command (Air Chief Marshal Sir Richard Peirse) and the head of Coastal Command (Air Chief Marshal Sir Philip Joubert)—a determined jaw and steady eyes which speak

of courage and resolution. With the Chief of the Air Staff, Marshal of the Royal Air Force Sir Charles Portal, they make up a formidable team, and as our strength in the air grows the offensive action of all the operational commands will grow correspondingly.

In the first year of the war aircraft of the R.A.F. Fighter Command flew the almost staggering distance of more than 17,000,000 miles—equivalent to seven hundred times round the world. That was in the days when the Command was composed of "those few," to whom the Prime Minister referred. Now the force is very much bigger, equipped with the most modern of machines and armament. Partly owing to the fact that they were operating over their own territory the majority of those heroes of the 1940 battles came through unscathed, and though many of them are still in the thick of the fight a proportion of them are now instructing later comers in the successful tactics they employed..

These men will tell you that, so far from any falling-off being apparent, the pilots of today are better than ever. Men from all corners of the Empire are rallying to the call to meet the German menace to their Mother Country, and from every part of the British Isles, too. That they will carry on the glorious tradition of the earlier warriors nobody need doubt.

CHAPTER FIVE

WINGS OVER THE SEA

"The work of the Coastal Command is indeed beyond all praise. It is work demanding qualities of the very highest order—qualities of skill, fortitude and courage."

The Air Minister in the House of Commons, August 1940

COASTAL COMMAND is like no other branch of the Royal Air Force. It is more than a command; it is an air force within the Air Force, for it has its own bombers and fighters, its own torpedo-carrying and mine-laying craft and its own machines for photographic and other reconnaissance work. Its duties are among the most difficult and arduous in the whole range of the war effort. It has a "parish" extending over the whole North Sea, from Iceland and the coast of Norway to the North-West coast of Germany, over the Low Countries and France, right down to the Mediterranean and approximately 1,000 miles out into the Atlantic.

Some idea of the work which this entails may be gained from the fact that in the first year of the war Coastal Command aircraft flew no fewer than 19,000,000 miles, which is equal to about 782½ times round the world. And yet when war started it was a tiny section of the Service and its duties were expected to be confined almost entirely to reconnaissance. Now it must be pre-

pared not only to fight and bomb, to shepherd convoys and attack U-boats and enemy aircraft bent on sinking our shipping, but to keep a constant look-out for any signs of invasion preparations.

During the early days the aircraft at the Command's disposal were totally inadequate, and the way in which that deficiency was made good is one of the standing jokes of the pilots who are now equipped with some of the finest machines in the world. It was a monstrous piece of bluff, but the Germans fell for it. Regular anti-submarine patrols had to be maintained, particularly in the North Sea, and when the right type of aircraft were not available all sorts of training and communication machines were pressed into service. These were known as the "Scarecrow Patrols," and they were carried out largely by auxiliary pilots. The 'planes did not carry anything as lethal as a revolver, yet as soon as enemy submarines spotted them diving down in a businesslike way they lost no time in submerging and they stayed down for hours, while the convoys steamed on peacefully, "guarded" perhaps by a Tiger Moth or some equally inoffensive light trainer.

Now the Command has a variety of the most up-to-date landplanes and flying boats. For general reconnaissance work there are Hudsons, Ansons, Sunderlands, Lerwicks, Stranraers, Londons and the American Consolidated P.B.Y. (Catalina) flying-boats. The torpedo-bombers are Beauforts; the long-range fighters, the Blenheims and the new Beaufighters. Spitfires and Hurricanes are also employed for certain reconnaissance duties. Some of the men

flying Hudsons are Dutch, former members of the Netherlands Naval Air Service, while a Sunderland squadron is composed entirely of Australians. The Command also has the services of a number of Polish and Belgian pilots.

Because its work is so much bound up with the sea it is only natural that Coastal Command should work in the closest contact with the Royal Navy and the Fleet Air Arm. Not only are naval officers attached to Command Headquarters, but the Commander-in-Chief, Home Fleet, is in direct communication with one of the four groups into which the Command is divided. The relations between the two Services are of the most cordial, and they work together without the slightest sign of friction. It is not at all uncommon for the machines of the Command to take part in operations alongside the Swordfish and Albacores of the Fleet Air Arm.

With the intensification of the U-boat campaign the work of Coastal Command has grown and grown. Air escort has been provided for something like 6,000 convoys, entailing a total of about 20,000 separate sorties by aircraft. During the past six months (this is being written early in 1941), the average monthly time spent on convoy duties has been something like 5,300 hours, and even that high total is likely to be exceeded in the future. On anti-submarine duty, as distinct from convoy protection, the monthly average is nearly 2,000 hours, while on reconnaissance about 3,500 hours per month are expended.

Machines of the Command have made several hundred

attacks on submarines, many of them completely successful, while they have also shot down a number of Focke-Wulf Condors and Kuriers, which the Germans are using for the long-range attacks on our ocean-going shipping. The technique of attack by means of torpedoes has been developed considerably in recent months, and many thousands of tons of enemy shipping now lies on the bed of the ocean as a result. On top of that a number of German ships are known to have been sunk by mines, while others have been destroyed in bombing attacks. Coastal Command has also shared with Bomber Command the work of trouncing the enemy submarine bases of Lorient, Bordeaux, Brest and others; it has helped to ferry American aircraft across the Atlantic; and it has engaged in the humanitarian work of saving life at sea.

At the beginning of 1941 the Prime Minister announced that the strength of the Command was being steadily built up to meet the constantly increasing demands being made upon it, and that process has been going on ever since. Obsolescent machines are being replaced, and as the aircraft become available new squadrons are being formed. If there is one thing more than another which this sort of flying demands it is a very high standard of navigational ability, and the pilots and navigators of Coastal Command are among the best in the world. Often the long-range flying-boats, such as the Sunderland, are out for sixteen hours at a stretch, most of the time out of sight of land. They fly in all sorts of weather and during the flight they may have to make

scores of major alterations in course. Yet the navigation is considered by the airmen no better than it ought to be when, at the end of one of these trying days, on sighting land they find themselves no more than a mile or two out in their bearings.

The Sunderlands are the giants of the Command. These great flying-boats are also the terror of all enemy aircraft, who never try conclusions with them if there is any way of getting away without a fight. The military version of the Empire flying-boats, they weigh 25 tons when loaded, have a crew of from eight to twelve and a range not far short of 2,000 miles. They are powered by four 1,000 h.p. Pegasus engines. Because of their bristling armament—guns stick out from them seemingly at all angles—the Germans call them *fliegende Stachelschweine* (Flying Porcupine). One of the most famous of the Sunderland squadrons is that of the Royal Australian Air Force, which is based in the West of England and in Scotland. We have to thank a lucky chance for the fact that we have had its services since the start of the war. Just prior to September, 1939, some officers had come from Australia to take over six Sunderlands which had been ordered by their Government for service "down under." When war broke out the Commonwealth Government willingly agreed to forego their claim to the aircraft, and what is more, they allowed the officers to stay in this country to fly them. That squadron has given a splendid account of itself.

The American-built Lockheed Hudsons have been another unqualified success. All the squadrons equipped with them have flown more than a million miles, and one

has covered double that distance. The machines have not only been first-rate for reconnaissance duties but have given an excellent account of themselves for bombing, and even, when the occasion demanded, as fighters.

The Avro Ansons, not "youngsters" by any means, have also given great service. Designed as reconnaissance machines, they have shown a truly remarkable ability as fighters, due largely to their power of manœuvre and the skill and determination of their pilots. Several cases have been recorded when they have taken on Messerschmitts, capable of almost twice their speed, and they sent them hurtling down. The attitude of the men of Coastal Command towards them is summed up in their expression, "Anson is as Anson does." Many of the pilots are sorry that the Ansons are being switched over to training duties, their active life over.

Much of the work of the Command is unspectacular, tiring and unproductive of positive results. For instance, machines fly in an endless chain, throughout the twenty-four hours, on patrols over the North Sea towards the Norwegian coast. Because they fly always in straight lines these men call themselves the "tram drivers." They may fly for hours and see nothing, but they are keeping that vital watch which is so essential for the safety of our food and munition ships. Others disappear into the dawn of the Atlantic, searching for enemies on, above and below the seas.

In order to compensate them for this tedious work the pilots are sometimes allowed to indulge in what they call "Private Blitzes"—that is to say, they are allowed to go

in search of some enemy target and bomb it after they have finished their normal reconnaissance work. Warships, supply ships, and aerodromes are the favourite objectives, and the pilots and crews are so keen on this change of work that they will sometimes forego a day off in order to make certain of some adventure. Sometimes the board in the squadron operations room showing their anticipated time of return will bear the added inscriptions: "But may be up to two hours late owing to private hostilities." These excursions have often produced splendid results. There is one recorded case of two aircraft which went off on a "Private Blitz" and returned after having obtained direct hits on a minesweeper and a supply ship and a near miss on a destroyer.

Sometimes the monotony of reconnaissance or convoy patrol work is relieved by bright touches of comedy. A Sunderland picked up a convoy far out at sea, and no sooner had it taken up its station than a ship at the tail of the steaming line began to signal by lamp. The word "onions" was spelt out in Morse several times—just that one word. The code book gave no possible explanation and the Sunderland signalled: "Message not understood. Please repeat and explain." But still the merchant ship continued to signal "Onions," so the flying-boat captain, who had other things to think about, gave it up and flew on to watch for submarines. Several days later the crew of the flying-boat received a letter from the skipper of the merchant ship. It was addressed to the Sunderland under its identification letters, "c/o Air Ministry, London." This is what the letter said:

"We had been listening to the wireless news and heard that you in England were suffering from an acute shortage of onions. My ship was loaded with onions, and I wanted to give the good news to the first bit of England we sighted—and you were it."

Another ship, sailing in convoy, had a strange white-bearded figure hoisted at the mast-head. An exchange of Morse signals showed that the ship had a cargo of fruit for the Christmas markets and had thought it appropriate to have a Father Christmas figurehead.

Generally speaking the work of the Command does not get much into the limelight; it is just sheer drudgery. Perhaps we should appreciate it at something nearer its full value if, every time we sit down to a satisfactory meal —and such things exist, even in these days of rationing— we were to remember that the men and machines of the R.A.F. Coastal Command have probably played a part in the shepherding safely to our shores of the ships that brought it from some distant part of the world.

Invaluable as has been the work of the Command in the air, it is not generally known that it also performs equally useful and essential work on the sea. It possesses, in fact, a "Navy" all its own. Dotted around Great Britain and Northern Ireland, wherever there is a Coastal Command station, and often at places where there is not, there are R.A.F. sea bases, housing an almost bewildering variety of craft. There are also a number of small ship-yards, complete with slipways, repair depots and work-shops.

Members of the R.A.F. Marine Section, as it is called,

all come under Coastal Command. Some of these men have what must surely be one of the most remarkable jobs in the war. They are paid special "danger money" to sit still (if OUR OWN aircraft will allow them to do so) and be bombed. Their "working quarters" are 40 feet-long boats built by a well-known constructor of racing craft, and they are specially designed to withstand hits with light practice bombs without serious damage to the vessel or the crew. To make these target-boats bomb-proof an ingenious compromise has been evolved. Since armouring the entire craft would make it too heavy for speedy work, if it would float at all, vital parts and controls, as well as the crew of three or four, are assembled amidships and hooded with $3\frac{1}{2}$ tons of stout armour-plate mounted on rubber buffers. The rest of the hull is unprotected but is packed with a special buoyant substance called onazate which is only one-fifth the weight of cork. Direct hits elsewhere than on the armour-plating simply drill holes clean through the hull without affecting the seaworthiness of the craft. A special method of hull construction makes "mending the holes" a comparatively simple matter.

These high-speed vessels are a considerable advance on the somewhat sketchy pioneer craft associated with the late Aircraftman Shaw (Lawrence of Arabia). The crew are housed in a small steel cabin, and they wear gas masks to protect them from the fumes of exploding bombs, crash-helmets rather like those worn by racing motorists, and ear-plugs. Armour-glass windows give the helmsman a good view fore and aft; radio keeps the craft in touch with

the "attacking" aircraft; and a safety tender is always near at hand. These vessels are extremely manœuvrable, and as the bombers try to hit it the helmsman zigzags this way and that, just as an enemy ship would do in real warfare. The crew are all expert escapologists, and when a hit has turned the ship over, as it often does, they wriggle, perhaps upside down, out of their "funk hole," jump overboard and right the ship, then scramble on deck again and signal to the aircraft that they are ready to be bombed once more.

The best-known members of the R.A.F.'s "Navy" are the high-speed launches used for rescuing airmen and seamen. At the start of the war these craft were unarmed, but they were subjected to so many cowardly attacks by the enemy—often when they were actually trying to rescue German airmen from a watery grave—that in the summer of 1940 it was announced that they had been fitted with defensive guns. These guns are not used except to defend the crew against illegal attacks.

The rescue launches, 63 feet long and capable of a top speed of 40 m.p.h. and a cruising speed of 32 m.p.h., are propelled by Napier aero-engines. Travelling at maximem speed they have an endurance of about 12 hours (sufficient to cover 500 miles), but their cruising range is naturally much greater. The weather has to be exceptionally bad to prevent them from operating, and some of their crews' achievements are epic stories of endurance and courage. Sometimes the men have been so badly buffeted by the mountainous waves that they have been unable to reach shore and have run out of petrol, drifting

for hours at the mercy of the angry waves. There have been many occasions when the cold was so intense that the salt water froze on the gunwales and deck, or when the sea was so rough that the crew were unable to see more than a few yards.

The launches are equipped with wireless and on their long sea searches they usually work in conjunction with "spotter" aircraft. Sea and air craft are linked by radio-telephone and the aeroplane guides the launch to the spot where men may be clinging perilously to a raft, floating helplessly in their lifebelts, or battling doggedly towards the shore in a rowing-boat or rubber dinghy. The launches have first-aid equipment and are fitted with several bunks for the accommodation of the wounded or injured. Nets can also be trailed over the gunwale to help exhausted men aboard.

The work entails the most accurate navigation, and for that reason it is an invariable rule that the officer in charge (who has the rank of flying officer) should hold the Board of Trade master mariner's certificate. All have consequently had mercantile marine experience and most of them formerly held commissions in the Royal Naval Reserve. The crew numbers ten, all of whom are experts at their own job. There are two first-class coxswains, three deckhands, two engineers and two wireless-operators.

Nowadays the rescue launches form part of a vast new organization known as the Directorate of Air-Sea Rescue Services, which was formed in the spring of 1941 with Air Commodore L. G. Le B. Croke as its head and Captain C. L. Howe, R.N., as his deputy. In the R.A.F.

the service is known as the "Salvation Army." The Germans have a somewhat similar organization whose craft operate off the coast of occupied territory and in the North and Baltic Seas near their own coastline.

The bigger body, in which the Air Ministry and the Admiralty both play a part, was created in anticipation of a resumption of air fighting on the scale of the 1940 Battle of Britain. Both sides need every trained man and take great pains to rescue them should they be shot down into the sea.

The rescue craft are stationed at control points all around the coast, and these points have at their disposal special flights of Lysander aircraft. They also work in close touch with the Royal National Lifeboat Institution, the Royal Navy, R.A.F. Coastal Command, the mercantile marine, the Coastguard Service, the Royal Observer Corps and the police. If a resident in a coastal area reports to the police having seen an aircraft or an airman come down in the sea the police know exactly what to do. Each police station is in direct communication with the nearest R.A.F. station, which loses no time in informing the appropriate rescue services centre of the spot to which a launch must be sent. At the same time a Lysander is sent out to help locate the machine or airman. On several occasions the prompt and accurate location of a crashed machine given by an Observer Corps post has enabled flying crews to be rescued, while more than once it has resulted in a valuable flying-boat being rescued and towed safely into port.

The Air-Sea Rescue Services knows the movements

of every British warship, merchant ship, convoy and friendly submarine in home waters, and several times messages have been sent to ships to go to the rescue of men who have come down outside the range of the launches. One case is on record of a message having been sent to a submarine which happened to be only 15 miles from the spot. Risking attack by hostile aircraft, it surfaced, picked up the British crew of five and brought them safely back home.

Although this Directorate has been running only a short time it has already justified itself handsomely, thanks in part to the help of the Royal Navy and the other organizations which co-operate.

Another type of boat in the R.A.F.'s "Navy," known as a dinghy, works in collaboration with Coastal Command's reconnaissance aircraft. When these flying-boats return from a photographic flight they signal immediately to the shore base. The fast little dinghies, fitted with outboard motors, race through the water to the aircraft, take over the exposed film and hurry it back to land. Here, motor-cycle despatch riders are waiting, and they carry the film straight to the photographic section, where the negatives are developed and prints made, so that the "readers" can extract military information from them in the minimum of time.

Sixty-feet pinnaces are used primarily for the servicing of Coastal Command's flying-boats, but they also spread flares for flying-boats and seaplanes alighting in the dark; they carry stores, recover practice torpedoes, and occasionally lend a hand in rescue work. These vessels,

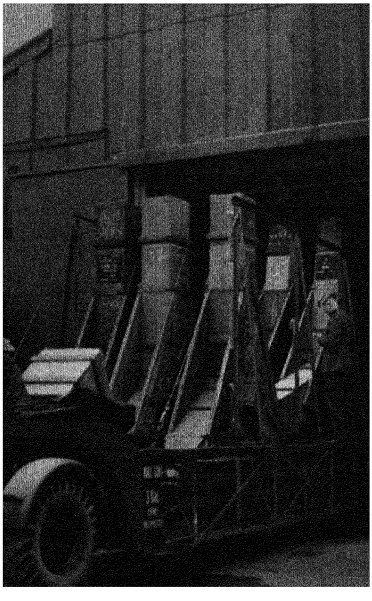
driven by 300 h.p. Diesel engines, are also able to operate in extremely rough weather. One instance will suffice to show their capabilities. An R.A.F. bomber, returning from a raid on enemy territory, had been forced to come down on the sea and the crew had taken to their dinghy. A 60-knot gale was raging and the seas were running mountains high. Despite careful criss-crossing searches of a wide expanse of the troubled North Sea other vessels had been forced to admit failure, but the pinnace forced its way through the white-topped breakers in the face of the gale and picked up the airmen. The wind did not abate, and it was not until five days after they had made their forced descent that the bomber crew regained land.

Also in the R.A.F. Marine Section are seaplane tenders, known in the Service as "crash boats." They stand by while heavily laden flying-boats take off, and should a mishap occur they can be on the spot in a few moments to rescue the crew. Bomb scows are the sea equivalent of the trolleys used on land aerodromes to carry the bomb-loads from the stores to the machines; while in place of the petrol trailers used for fuelling bombers there are miniature tankers, with a tank capacity of 2,500 gallons.

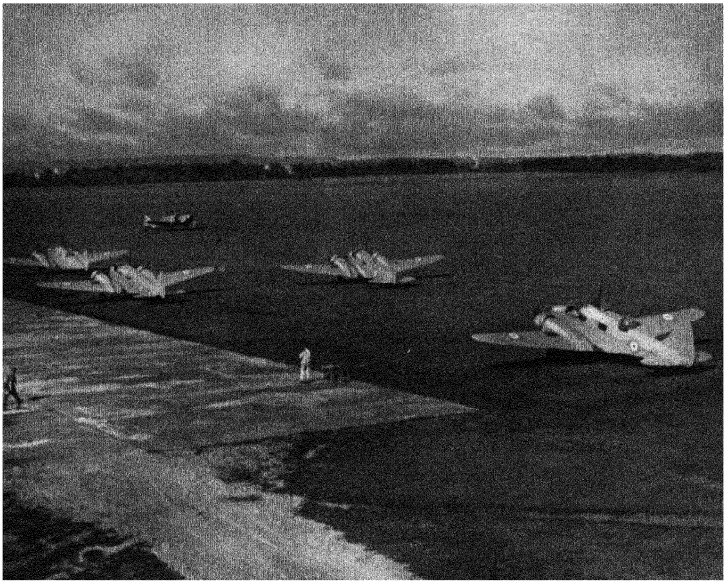
Another strange job is that of the mooring-boat crews. They spend the whole of their working time going round and round the coast of Britain keeping an eye on the mooring sites to which the flying-boats are secured. By the time they have finished one "circuit" it is time to start all over again. These men must get bored stiff with the monotony of it all, yet they seem quite content with



IN A FACTORY PRODUCING
WHITLEY BOMBERS



THESE STRANGELY-SHAPED
BOXES CONTAIN AIRSCREWS



AIRSPEED OXFORD TRAINERS
on Trenton Airfield, Canada



ROYAL
CANADIAN
AIR FORCE
recruits re-fuel-
ling an aircraft

their work. A more typical lot of "old salts" than these crews would be difficult to find.

This little known R.A.F. fleet is completed by the trawler and drifter auxiliaries and the pilot-cutters, which are used chiefly for aircraft torpedo practice and for retrieving the torpedoes. Special types of missiles are used and the auxiliaries twist and turn like hares being chased by greyhounds as the aircraft dive at them and practise this effective form of attack. The crews of the trawlers, drifters and pilot cutters may, generally speaking, have a pretty humdrum existence, but they certainly have their moments of excitement.

Perhaps no other section of an air force in any country in the world has such a varied or responsible task as that of Coastal Command. As the enemy's attacks on our shipping have been intensified their work has become more and more arduous. It will be no easy task to keep the German submarines, surface raiders and aircraft at bay, but our safety and livelihood depends upon it. That is why Coastal Command has been expanded, in the short space of eighteen months, from a comparatively small unit into one of the greatest Commands in the R.A.F.

CHAPTER SIX

LINKING AIR AND LAND

IT is probable that the Army Cooperation Command of the R.A.F. owes its birth to the success of the German tactics in France and the Low Countries. Employing their aircraft in close support of the Army, they were able to clear the path for their fast-moving mechanized columns and to advance them at a pace which took both the French and ourselves by surprise. We have not been slow in learning the lesson, for although the new Command has been in existence only since December, 1940, it has proved its worth in the campaigns on all the African fronts and made the task of General Wavell's Army much easier than it might otherwise have been.

No man with a better understanding and appreciation of the problems of air-land collaboration could have been found than Air Marshal Sir Arthur Barratt, for he was the Commander-in-Chief of the British Air Forces in France during the 1940 fighting on the Continent. His Command was divided into two parts—the Advanced Air Striking Force, which worked independently in the traditional manner of the Royal Air Force, and the Air Component, which was a mixed unit of bombers, fighters and reconnaissance machines put at the disposal of Lord Gort and his staff. The separate Command since set up is a

logical development of the earlier arrangement, and appropriately enough, Air Marshal Barratt has been put at its head.

Apart from the fighting in the Balkans and Middle East, Army Cooperation Command has not yet been in action, but if and when the time comes for land operations to be reopened on the Continent it will play a most important part. There seems little room for doubt that now that armies are mechanized a section of the air force set aside to cooperate with the land forces will be a permanent feature, for in addition to tactical reconnaissance—observation of enemy movements—it can carry out photographic and strategical reconnaissance, "spotting" for the artillery, bombing and ground attacks with machine-guns, and it can drop urgent ammunition or supplies to troops which for various reasons may not be within reach from the ground.

An Air Ministry report on the part played by an Army Cooperation squadron with General Wavell's troops during the offensive which ended in the capture of Bardia shows the importance of its task. In the first part of the forward movement it was essential to know the disposition of the Italian troops guarding Sidi Barrani. Aircraft went out as late as the afternoon before the attacks, and prints showing the sectors they had to capture were in the hands of the local Army commanders in time for the assault early the following day. On one occasion the squadron's photographic staff worked for twenty-four hours on end in order to produce the necessary prints. During the siege of Bardia itself, artillery "spotting"

for the Australian and English gunners was carried out with great success. "Big Bill of Bardia," with which the enemy had dropped shells periodically into Sollum, caused some difficulty, and the squadron soon discovered its hiding place and caused it to go out of business.

Another way in which there has grown up recently closer collaboration between land and air forces is through the new technique—new to this country, but started first in Russia and copied by Germany—of dropping soldiers by parachute from special types of aircraft. Germany made extensive use of parachute toops on the Continent, in Norway, Greece and Crete, but until British soldiers appeared out of the Italian sky early in 1941 it was not known that we also had trained men for this dangerous and highly specialized work.

Army Cooperation Command is divided into groups, one of which is concerned with training and development and another composed of the operational squadrons working under the orders of the Army commanders. Army officers are seconded to the Command for service with the various squadrons as intelligence officers. It is their duty to "brief" the A.C. pilots, on behalf of the Army Corps or Command, on the missions which the Army want them to undertake. When the pilots have carried out their orders they report to Army officers, known as air intelligence liaison officers, who sift and analyse the pilots' information in much the same way as does the R.A.F. intelligence officer attached to a Bomber Command or Fighter Command squadron. An R.A.F. officer is attached to the headquarters of the Army unit

with which his squadron is working, and in this way each Service gets to know quite a good deal about the work and methods employed by the other.

For some time now Army officers who wished to do so and who passed the medical and educational tests and concluded their flying training, have been accepted as pilots for Army cooperation work. After a time there will be an almost equal number of Army and R.A.F. pilots in the Command, but it will be impossible to tell which is which, for they all adopt the blue of the R.A.F. All A.C. pilots go through the normal initial training wing, the elementary flying training school and the Service flying training school, but instead of completing their instruction with a fighter or bomber operational training unit they are drafted to one of the Army Cooperation Command schools. Here they complete a highly-specialized course which is divided into three stages.

During the first weeks they are taught how to pinpoint such objects as churches, hayricks and ponds and are sent on elementary reconnaissance of the surrounding countryside. Sheep represent troops and cattle are supposed to be tanks and mechanized units, and they send back their information by Morse. Next they study the extremely complicated art of aerial photography, which, properly carried out, is one of the most difficult jobs in the R.A.F., calling for extremely accurate flying. These things having been mastered, the embryo pilot passes on to the second part of the course. More advanced forms of reconnaissance involve the finding of actual troops, and the pupil cannot hope to "get away with" any flights of

imagination, for the Army chiefs have informed the air station just where their troops are and in what strength. Next come artillery spotting and live shoots with the gunners, and in the third and last part of the course the pilot is taught air firing, bombing, evasive tactics, and ground "straffing." The air firing involves not only himself aiming the front guns but flying into position so that his rear gunner can manipulate his guns.

As in all the other Commands of the R.A.F., there are many ingenious devices on the ground which give the trainee-pilot excellent practice for air operations. The best known is the Haskard target, invented, appropriately enough, by an Army colonel of that name. It consists of a realistic model, about 30 feet square, representing a stretch of actual English landscape as it would look to a pilot flying at the normal reconnaissance height of 3,000 to 4,000 feet. It is complete with roads, rivers, lakes, canals, hills and valleys, while magnets operated by men hidden under the floor of the scenery can move trains, tanks or other mechanized units, and an automatic device emits puffs of smoke to represent the explosion of artillery shells. The pilot stands on a platform from which he can see the whole of the landscape, and he is connected by a Morse key to "gun positions" also operated by men under the floor. The pilot can "go on reconnaissance" and report troop movements, the bringing up of supplies by rail or road, and he can send down corrections of range and direction for the gunners. It also gives him excellent training in wireless-telegraphy, with all its codes and abbreviations.

During the last war air reconnaissance could be a leisurely business consisting of cruising about and observing what was going on. Not so in this war. To amble along at a nice, convenient height and speed would be to court disaster from ground defences or enemy fighters, and so an entirely new technique has been worked out. That is constantly being practised in manœuvres with the Army, and all the operational pilots in the Command are familiar with it.

One of the most important branches of the work of Army Cooperation Command is air photography, although there are air reconnaissance units attached to all the operational Commands of the Royal Air Force. This is an art in which great strides have been made in recent years, and improvements are still constantly being made. During 1914–18 a reconnaissance aircraft was reasonably safe at 8,000 feet, and from that altitude good pictures could be obtained in daylight, but now it would be risky for a photographing machine to operate at much below twice that height, so that technical development has been necessary to keep pace with the changed conditions.

The ability to secure good, informative photographs from such a height has not been obtained without much experiment and research. It is fairly obvious that the greater the height from which a picture is taken the smaller the scale of the photographed area becomes. To "bring up" those details long-lens cameras were employed, but these in turn had their drawback, for they called for more accuracy of aim with the camera and consequently increased the chance of missing the mark

altogether. Bigger cameras were thought to be the solution, and often more than one in an aeroplane, but these presented difficulties of installation. Another serious drawback to photographing at great heights was that cameras frequently froze, and condensation formed on the lenses. Cameras were also affected by vibration and by the high speed of the aircraft from which they were taken. All these problems have now been solved.

Nowadays pictures taken during darkness can be almost as detailed as those secured in daylight, although searchlights, bursting anti-aircraft shells and incendiary bullets sometimes defeat the camera. Under favourable conditions, however, the R.A.F. photographic section can guarantee to supply a perfect night picture taken from a height of 4,000 feet. The lenses used for night photography have a much wider aperture than those employed in the daytime. Flash-bombs are used to illumine objects on the ground and the flash automatically closes the camera shutter by means of a photo-electric cell.

Aerial photographs are not only used to ascertain the effect of bombing raids; in fact, they are frequently the evidence upon which Bomber or Coastal Command satisfy themselves of the presence of some desired target, such as a ship in dock. Much of the information about ship and troop movements is procured by photographic or other reconnaissance machines. After the raid has been carried out photographic aircraft go over and photograph the target area. The pictures obtained on such occasions have frequently given the lie to Goebbels' claims that no military damage had been caused by our bombs.

The aerial camera is now a "precision instrument," simple to handle and standing up to a great deal of hard wear. When employed for taking vertical pictures it is operated electrically and starts at the turn of a timing switch. The control unit continues to make exposures at set intervals either until it is switched off or the film has run out. After the release of the shutter the mechanism automatically drops into mesh, rewinds the shutter, winds over the exposed portion of the film, and changes the number on a Veeder counter. Like some of the older types, the modern camera is built on the unit system, and any part can quickly and easily be replaced, no special tools being needed for dismantling.

The extreme cold which used to be the principal cause of jamming at high altitudes has been overcome by a heating arrangement which prevents excessive contraction of the shutters; while new mountings, increases in the speed of the shutter movements and of the panchromatic emulsions, have nullified the effect of engine and other vibration and stopped the blurring caused by the fast forward movement of the aircraft.

The laboratories, the advice and the results of experiments and research of the two biggest photographic firms in the country are constantly at the disposal of the R.A.F., so that not only in cameras and films but in processing methods improvements are constantly being introduced. As a result, finished prints of pictures can now be handed on to the "readers" attached to the Army or to Bomber or Coastal Command in a fraction of the time which was possible as recently as during the first few months of the

war. Faster and better films permit of wide margins or error in exposure, either "over" or "under," while the laboratories have contributed emulsions for films of greater speed and sensitivity and finer grain; panchromatic coatings which give better results; a bromide emulsion which provides for either contrasting or soft effects in printing, according to requirements; and have made possible the extensive use of infra-red films.

All the operational squadrons of Army Cooperation Command are equipped with travelling developing and printing trailers, in which have been fitted the most up-to-date time- and labour-saving devices. The processing of films has been considerably speeded up by a series of tanks into which the exposed film is put at one end and comes out at the other developed, fixed, washed and dried ready for printing. There is also the "multiprinter," which can supply any required number of prints of an important negative. The R.A.F. has plant which is capable of turning out as many as five hundred prints an hour from any negative.

In these days of fast-moving troops and ships time is one of the most important factors which determines the usefulness of an aerial picture. Produced at one moment it may result in the destruction of a vital enemy target; available half an hour later it may be useless. That is why any invention which can cut down processing times is adopted without delay.

The camera also plays an important part in the training of pilots and air gunners. Camera- and ciné-guns replace the machine-guns or cannons which will be used in

battle, and when the films are thrown on a screen they show the marksman where he has gone wrong.

So much importance is attached to aerial photography that the R.A.F. maintains its own school where men receive a thorough training. The trainees must attain a high standard of proficiency before they are sent out to work with a squadron, for a "foozled" photograph may well rob our bombers or our Royal Artillery of an important victim.

Army Cooperation Command has at its disposal not only reconnaissance machines but bombers and fighters, and these are always available to act under the orders of the Army. Some time ago the Prime Minister stated that new machines would be provided as and when they became available, and that process is proceeding steadily. Having seen how vulnerable the Junkers 87B dive-bombers were to ground attack, Britain is not making the mistake of going in for similar types of machines, but all the same, we have a new type of bomber, considerably less vulnerable, which can achieve similar result without risking such crippling losses as the Germans suffered during the short but hectic campaign in France.

CHAPTER SEVEN

OUR SILVER SENTINELS

PERHAPS it is because they have become such a familiar war-time sight throughout the country that we are apt sometimes to forget the valuable part played in our defence against air attack by the balloon barrage. Perhaps it is because that, riding silently overhead, the balloons have an appearance of cow-like docility. How badly they belie their appearance can only be known by those who have seen them, on a gusty day, bucking like high-spirited broncos as the perspiring crews struggle to get them down. There is nothing docile about them then.

That the Germans place a high value on them is proved by the great care with which they avoid coming below their level; by their efforts to destroy them; and by the fact that they also protect their important areas with them. That the British authorities have faith in them is shown by the fact that every month sees more balloons sent up. The balloons cannot prevent a city, town or factory from being bombed, but they can and do prevent the enemy from coming low enough to be sure of his aim.

Their success should not be judged by the number of German aircraft that they have brought down—though they have enjoyed their unspectacular successes against unwary night bombers. Their job is to keep raiders too

high to obtain accurate results and at just the right height for our anti-aircraft guns to bring them tumbling to earth. They have also played an invaluable part in the defence of our convoys as they steam up the narrow waters of the English Channel or approach the danger areas of the Atlantic and North Sea which lie within range of Germany's Condors, Kuriers, Heinkels, Junkers 88's and Dorniers. The dive-bombers have not been so keen on screaming down on our merchant ships since their active defences were supplemented by balloons.

In September, 1940, it was announced that the size of the balloon barrage had been doubled since the outbreak of war. One difficulty has always been to keep the cables strong enough to be lethal and yet not too heavy to prevent the balloons from soaring to an effective altitude. Colonel Llewellin, Parliamentary Secretary to the Ministry of Aircraft Production, stated in Parliament in reply to the debate on the 1941 Air Estimates that that difficulty was being overcome, and they believed that a way had been found of sending the balloons higher still. When the entire barrage covering Britain is composed of those high-altitude balloons the German bombers' task will be more difficult than ever.

Like every other branch of the Royal Air Force, Balloon Command has its own organisation and its own commander-in-chief, and it controls all the barrages throughout the country. Because it would be impossible to supervise from a single headquarters the vast area of England, Scotland, Wales and Northern Ireland the Command is divided into groups, the largest of which,

not unnaturally, is London. The groups are themselves sub-divided into centres, and each centre has its squadrons, flights and balloon sites. The centres correspond to a wing on the operational side of the Service. The Metropolitan area is served by four groups.

Contrary to the general belief, Balloon Command was in existence before the outbreak of war. Its roots had been firmly planted some time before "the balloon went up," and it had worked out detailed plans for functioning under war conditions, just as it has its own plan of campaign in case the enemy should attempt an invasion.

It is the groups which direct the actual manipulating of the balloons. Each has its meteorological department to advise it on weather conditions, which, of course, have an important bearing on the height at which the barrages are to work. In the light of the weather forecasts the group commanders decide at what height the balloons shall be flown, when they shall be grounded, and when sent up again. Group Headquarters is linked to its squadrons by telephone, but in case of failure of this means it has another speedy method of communication.

The centre feeds, clothes and pays the men of its squadrons, flights and sites; it is responsible for the maintenance of its not inconsiderable motor transport section and for the supply of gas for inflating the balloons; it has its own medical officers, accountants, catering officer, butchers, cooks, Service police and office staffs; it supplies, replaces, and repairs all the balloons in its area; and it has its own central depot.

Because a group must be able to do all these things its

depot runs to pretty considerable dimensions. At first glance it is not unlike a bomber aerodrome, but soon one notices that the hangars are much higher buildings (for they must house balloons instead of aeroplanes) and that there are a number of large workshops. Most of those shops are used for making and repairing balloons, and they contain thousands of yards of the specially proofed cotton fabric from which skilled workpeople turn out the gas-containers and the air-filled "fins," or stabilizers, which give the balloons their animal-like appearance. The heavier work is done by men, but the women of the W.A.A.F. have proved themselves expert in stitching and cutting the fabric. Power-driven sewing machines have speeded up new construction and repair work very considerably.

The surfaces which have to take the heaviest strain are reinforced on the inside by circular discs of some tough material, known as diaphragms, and by strong tape. Nearly all this work is performed by women—and they do it extremely well, as one would expect with a job which is not unlike many of the tasks which a housewife does.

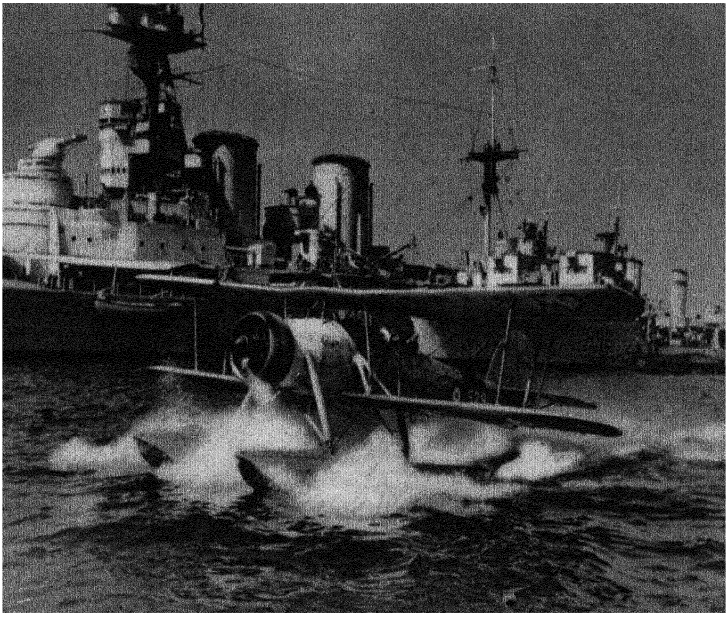
A brand new or repaired balloon is first tested in an inspection hangar, being inflated by means of high-speed pumps. It is vitally important that even the smallest leak should be stopped up, because the escape of gas leads to a dangerous, inflammable mixture which may bring the balloon crashing in flames. It is for the same reason that balloons which are "on active service" are hauled down each day, whether or not they are suspected of leaks caused

by anti-aircraft shell fragments or bad weather. If the gas is found to contain less than the regulation degree of purity the balloon is deflated and refilled.

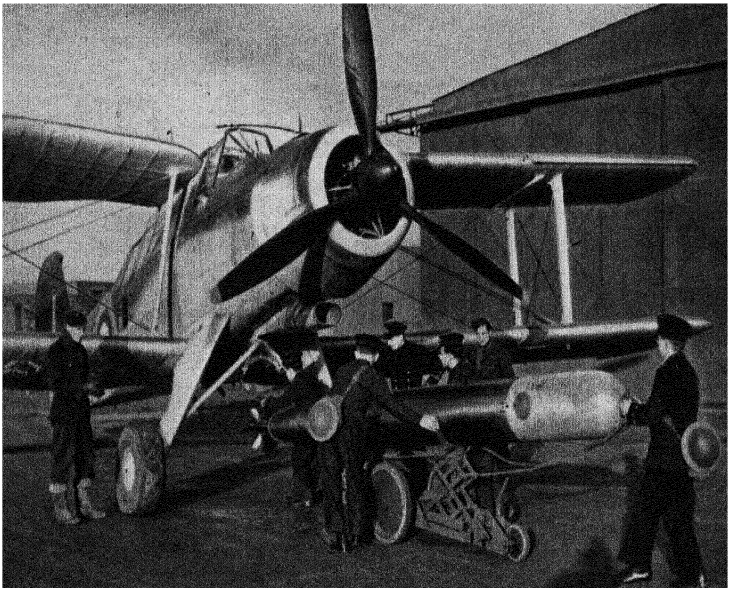
Many thousands of people must have noticed the gas being delivered to the sites every day on special trailers stacked with ten long cylinders. What is known as a "ten-way filler" enables all the cylinders to be drawn upon at the same time, and in this way the balloon can be filled in well under half an hour. The inflation speed can however, be controlled by pressure.

Food supplies are distributed daily from the depôt to the flights, each of which has its own cooking facilities. Most of the catering officers are in the trade in peace-time, while many of the butchers and chefs are "professionals." The result is that the men of Balloon Command are particularly well fed. Men operating in rural districts have been found to possess healthier appetites than those employed on town sites and in offices, and so the former have a different diet—something on the lines of what West Country folk call "good old substantial." When the flight cooks have prepared the meals they are taken to the sites in the now familiar "hay-boxes," which appear to be completely satisfactory.

The men who tend the balloons are a mixture of Regulars, R.A.F. Volunteer Reservists and members of the Auxiliary Air Force. Many of them saw service in France during the 1940 campaign, maintaining the barrages over the ports. One of the squadrons which has been engaged in guarding a part of North London—it is probably still doing so—was in charge of the balloons over Le Havre,



A FLEET AIR-ARM SWORDFISH TORPEDO-CARRIER
taxi-ing past H.M.S. *Hood*



TRAINING NAVAL PILOTS
Loading a torpedo on to a Fleet Air Arm Albacore

and though their balloons were shot down one after the other by German fighters they stuck to their post as long as there were British ships to be protected. The squadron got back to England without suffering a single casualty, and with a good part of their stores. Another squadron which was in France seemed likely to have to desert or destroy their balloons, but on the day they were leaving a good fairy sent a favourable wind, blowing in the direction of England, and so the cables were cut and the balloons drifted gently over the Channel. Many of them were recovered intact in this country.

In the bitter winter weather of early 1940 the balloon men had an unenviable task, but they kept at it cheerfully and tirelessly. When gales raged their charges behaved like things suddenly possessed of a devil. To bring them down was to accomplish something akin to taming a wild horse or a mule of the Army variety. When they seemed to be at last under control they would suddenly kick out again and threaten to twine themselves round the chimney of a nearby house, into the branches of trees, or over electric pylons or telephone lines. There is no doubt that, in the hands of inexperienced men, a "bucking" balloon could soon cause a serious amount of damage to the very building it was designed to protect.

Before a balloon is inflated on a site it is stretched on a ground-sheet, or bed, and connected to an intricate network of cables, pulleys, ground-blocks, handling guys and several other things called by mysterious technical names. The end of the cable is attached to a travelling winch, which is operated in exactly the same way as a motor-

car. The speed at which a cable is paid out or hauled in can be controlled by the winch-driver by the simple process of pressing lightly or heavily on a pedal situated where the accelerator is on a car. When a balloon needs inspection it is hauled, by means of the winch, to within a few feet of the ground and thereafter it must then be man-handled. The crew then range themselves around the bed and fix the handling guys. When they are safely on they can breathe a sigh of relief, knowing that the balloon can give them no more exhibitions of its caprice until they start to let it up again.

CHAPTER EIGHT

THE "UNIVERSAL PROVIDER"

MAINTENANCE COMMAND is the "universal provider" of the R.A.F. It supplies everything from a button to an aeroplane.

Like the operational commands, it is divided into groups, but the divisions are functional and not geographical. One group looks after equipment; one after aircraft; one after ammunition, fuel and oxygen supplies; and one after salvage and repair. Also under the Command is the Overseas Air Movement Control, which supervises the packing of aircraft for shipment abroad.

It is the responsibility of Maintenance Command to meet the requirements of the R.A.F. up to the point where maintenance becomes the responsibility of the operational units—that is to say, up to the point where it becomes running repairs. Some idea of its scope may be gained from the fact that it has a total personnel strength which now runs into six figures. The turnover of equipment and ammunition depôts averages nearly 100,000 tons a month, while the distance covered by its motor transport is in the neighbourhood of 1,750,000 miles per month. The ton-mile figures for a full year are astronomical—about 1,500,000,000,000, which is equivalent to

carrying one ton 68,000,000 times round the world. The Command's "stock" consists of 750,000 different items, varying in weight from less than an ounce to many tons, any one of which may be demanded at any time of the day or night. The Command aims to be able to deliver any requirement of an operational unit within forty-eight hours of receiving the order, and it is rare for it to be unable to do so.

The group responsible for the supply of aircraft works in close liaison with, and virtually under the control of, the Ministry of Aircraft Production, which is ultimately responsible for all aircraft supplies, whether from the British factories, those in the Empire or in the United States. Aircraft are sometimes supplied by the industry complete only to flying condition, and this maintenance group must then take them over and fit them for operations. The holding of any individual air storage unit (of which there are several in different parts of the country) is always a mixed one; that is to say, the various types of aircraft and engines are so stored that the destruction of one unit could not wipe out the reserve stocks of a particular type or even create a temporary shortage.

Aircraft arriving in this country from overseas are taken by the ferry pilot to their allotted destination and handed over to the Air Movement Control Unit. It is possible, during a visit to such a unit, to know at any time the approximate position of any aeroplane being flown to this country across the Atlantic, what sort of weather it is encountering, and details of that sort. The prevailing weather over other important areas, such as the Medi-

terranean, can also be ascertained by reference to a coloured map.

Covered by the heading of equipment are such things as clothing, barrack stores and general stores, including a normal supply of airframes, aero-engines and motor transport spares. Every article issued, big or small, is noted and the record kept in one central office, known as the Master Provision Office, which controls supplies according to probable requirements. An average of four hundred signals a day, demanding this and that spare part or store, arrive at the equipment depôt. If the item can be supplied from stock it is done immediately, but if not, the order is again signalled to another unit. The Demands Control Office is the hub of the unit, and the system employed has been adapted to Service methods and requirements from the experience of the big distributing firms. Most of the staff are civilians, culled from a variety of peace-time occupations. Recently—and maybe still—there were people who had been respectively a house-demolisher, an international footballer, nurses, travellers, a clergyman, a miner, a carpet weaver and a bookmaker.

The salvage group handles both British and enemy machines which may crash in this country. It is also charged with the responsibility of recovering any aircraft which has come down in the sea above the high-water mark. Below that mark the responsibility is that of the Marine Salvage Section. When a crash occurs the nearest R.A.F. station notifies the salvage centre, who must have the machine removed and repaired, or, if it is damaged beyond redemption, must dispose of the metal and

rescue any parts which can be used again. Repair depôts are expected to be capable of repairing anything which becomes unserviceable—motor transport, airframes, aero-engines, barrack stores, aircraft radio, and a host of other things too numerous to enumerate.

As soon as it is informed of the whereabouts of a crashed aeroplane the salvage depôt sends out an officer known as a Crash Inspector to "size up the job." It is for him to decide whether the damage is repairable on the spot, whether the machine is worth repairing at all or whether it must be written off and used only for scrap. There are different types of crews in readiness for all these types of jobs. Personnel of the dismantling squads undergo special courses of instruction in the aircraft factories, so that they are familiar with the construction of the various types of Service machines and engines and can dismantle them without doing further damage. It is almost inevitable that when a machine crashes it damages not only itself but the property on which it has fallen. It may be only a potato crop that has been interfered with, or a hedge or wall which has been knocked down, or it may have caused serious damage to a building. A Claims and Damage Officer attends to such things, although the Crash Inspector submits a preliminary report on "other damage."

This unit alone covers nearly 100,000 miles a month by road. As one might expect, a large percentage of crashes of an accidental nature occur in the most difficult kind of countryside, sometimes in places where salvage would seem to be almost an impossibility. On one occa-

sion a machine hurtled into the side of a mountain at a spot 2,800 feet up. The weather was dreadful—cold and stormy, and there was 2 feet of snow on the ground. No transport could be got to within two and a quarter miles of the scene, and the intervening ground was mostly composed of difficult and dangerous rock. Yet the machine was dismantled and every part was man-handled all the way back to the breakdown van. It took sixteen days to complete the removal.

Another aircraft crashed into a bog high up in the Welsh Mountains. A tractor which was taken to the spot sank into the bog until it had almost completely disappeared, so before work could be started on the aeroplane a scheme had to be devised for rescuing the tractor. A channel was dug and the water slowly drained away, and after much gruelling labour both the tractor and the aeroplane—a large bomber—were hauled out. Still another ticklish salvage operation was successfully completed from a gully on the top of Plinlimmon—no mean feat.

Many of the ammunition depôts are underground, consisting of huge tunnels deep into the sides of mountains and hills. Where this is impossible the explosives are kept in specially protected buildings. Supplies of bombs and ammunition are sent out, as required, from the depôts to what are known as forward holding parks, which are more conveniently situated for direct supplies to the operational stations. Stores of oil and fuel are controlled, on an agency basis, by the Petroleum Board, but Maintenance Command is responsible for ensuring a

smooth and uninterrupted supply to the consuming stations. One of the most interesting processes performed at the Aviation Fuel Reserve and Distributing Depôt is that of blending the aviation spirits, which is an extremely important factor in aircraft performance.

The repair depôt is expected to restore almost any mechanical device used in the air. Here, skilled workmen can dismantle and repair such things as engines, flying instruments (anything on the normal panel of a cockpit), wireless, and so on.

There are special depôts to which crashed German aircraft are taken. During and after the Battle of Britain these depôts were piled high with literally hundreds of twisted and broken Messerschmitts, Junkers dive-bombers, Heinkels and Dorniers. When new, the machines thrown into these mountainous heaps must have cost millions of pounds, but now most of them were destined for the ignominious end of being melted down to be used against their makers.

Sometimes enemy aircraft are recovered intact or so little damaged as to make no difference, and from these, men with specialized knowledge of engines, radio, armament, metals and armour have learnt all the secrets which the Nazis guarded so closely. Thanks to these men's work the R.A.F. knows all the weak and strong points of the German machines, knows their speed and performance, and is able to tell its pilots what form of attack is most likely to bring success.

Each broken machine brought in is examined for new devices, and then, if it is no use for anything else, it is

melted down and may become part of a Spitfire which is going to bring down more of its kind, or of a Stirling, Wellington or Whitley which is going to try to destroy the factory where its brethren are being made.

These wrecked enemy machines perform another useful service, for the metal used in their construction can be analysed. Any hint of *Ersatz* would soon be unearthed, but despite many "wishful-thinking" rumours to the contrary, there has been no sign of substitute metals or material so far. Some of the instruments on the earlier Messerschmitt 109s were rather crude, but such things as radio—and this applies to all the German machines—have been found to be elaborate. Their great disadvantage as compared with the British aircraft radio is their weight, many of them being as much as three times as heavy as our own.

Once the experts have decided that the crashed German machine is no good for anything else, it is sent to one of the several depôts to be melted down. The carcase is first cut apart with oxy-acetylene blow-pipes and then the metals are sorted. The more obvious steel parts, such as the landing gear, are immediately put aside to be sent to a steel works, and copper and brass components are separated. The pieces composed mostly of aluminium alloys are then sorted by hand, the steel rivets and cables being cut out. This leaves the alloy parts, which are melted down in huge furnaces. Before they are used again the aluminium alloys are mixed with a specified quantity of new metal.

The same procedure is, of course, followed in the case

of British machines, but every care is taken to remove all parts which can be repaired and put back into service.

Most of the work of Maintenance Command is unspectacular, but every member of the R.A.F. knows that the success of the operational and training Commands depends upon its efficiency. Though it has had more than a normal share of being "Blitzed" it has carried out its work efficiently and tirelessly. It might well adopt the motto, "If you want something, we've got it."

CHAPTER NINE

WOMEN IN BLUE

"I congratulate you on the fine courage and discipline shown by all ranks of the W.A.A.F. in recent actions. They are well worthy of the great Service to which they belong."

The Air Minister

THIS high tribute to the Women's Auxiliary Air Force, sent by Sir Archibald Sinclair to the Director, Air Commandant J. Trefusis Forbes, shortly after attacks had been made on several R.A.F. stations, was thoroughly deserved, for these girls in blue have not only shown magnificent pluck under fire but are paying an ever-increasing part in the ground work of the Service.

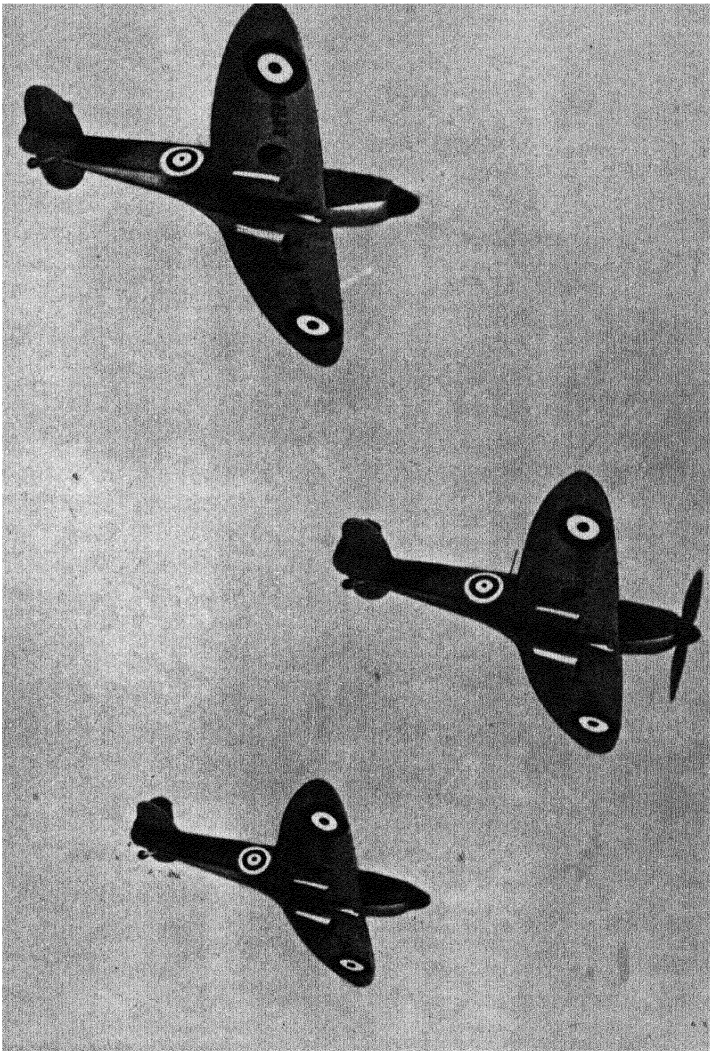
In peace time members of the W.A.A.F. were employed only for jobs which were obviously "up their street," such as cooking and other domestic occupations. Since the war started, women have been trained to do a variety of jobs, until now they form an indispensable part of the war-time Royal Air Force. They have taken to many unfamiliar tasks in a most adaptable manner and are now engaged in no fewer than twenty-five trades, formerly followed only by men.

A Women's Royal Air Force was created in April, 1918, at the same time as the amalgamation of the R.F.C. and the R.N.A.S. brought into being the R.A.F. When the

A.T.S. was formed in July, 1938, certain companies were allotted to the R.A.F., but this arrangement could not provide anything like the number required for a rapidly expanding Air Force and the duties were completely different, so on June 28, 1939, the Women's Auxiliary Air Force was established by Royal Warrant. The Queen became the Commandant-in-Chief and Miss Trefusis Forbes was appointed Director, with the rank of Air Commandant, which corresponds to that of Air Commodore in the men's side of the Service. The Duchess of Gloucester was also gazetted an air commandant in March, 1940. Since the outbreak of hostilities the organization has expanded at a rate corresponding to that of the R.A.F., and today there are airwomen on almost every R.A.F. flying station and establishment throughout the country, with their own officers and their own directorate. They rank as part of the Auxiliary Air Force.

When the women working with the Air Force were merely a part of the A.T.S. the only distinguishing feature of the uniform of the "R.A.F. Companies" was a Royal Air Force eagle embroidered in red on each shoulder of the khaki jacket. The decision at that time not to dress the women in blue was due to the dearth of blue cloth, all of which was required for the rapidly growing Air Force. The final word on the uniform was actually given by Air Marshal Sir Charles Portal—then Air Member for Personnel. He said, "It must be blue."

A new style uniform was then devised, the authorities wisely giving consideration to the women's own point of view. The result was the present distinctive blue uniform,



SUPERMARINE SPITFIRES
FLYING IN FORMATION



AS THE SUN SETS
A Whitley bomber takes off on a raid
over Germany

with its slightly flared skirt and a tunic and cap which follow as closely as possible those worn by officers and men of the R.A.F. A special feature, unique in the uniforms of women's services, is that badges of rank, as well as cap badges and buttons, are identical with those of the fighting Service to which the women are attached. At first there was some doubt as to whether the cap and buttons of the R.A.F. could legally be adopted by the W.A.A.F., but this was settled when it was shown that similar badges and buttons were worn by the Princess Mary's R.A.F. Nursing Service.

When Royal approval for the uniform was sought it was suggested that a different head-dress might be an improvement, but the King left the choice to the members themselves, and they chose the peaked cap.

The W.A.A.F. conducts its own recruiting on much the same lines as the R.A.F. After being enrolled a woman is sent to one of the two training depôts, where she undergoes a fortnight's disciplinary training. For some trades it is necessary to pass a selection board. Trained women are then posted to R.A.F. stations, but those with little or no previous knowledge of their trade receive a special course of tuition.

There is no direct entry for officers, all of whom are promoted from the ranks. The women undertake to serve anywhere, including overseas. At each R.A.F. station they have their own officer, their separate mess and their recreation rooms, their own N.A.A.F.I. and their own range of sports. Though participation is not compulsory, they show great keenness for such sports as fencing,

lacrosse, hockey, lawn tennis, roller skating, squash rackets, badminton, net-ball, swimming, cricket and cross-country running. Physical training is equally popular. Sometimes the instructors are men and sometimes women.

The ranks are much the same as in the R.A.F., but because officers do not hold commissions there cannot be N.C.O.s, and the women are called sub-officers. The officers' ranks are assistant section officer (corresponding to pilot officer), section officer (corresponding to flying officer), flight officer (flight lieutenant), squadron officer (squadron leader), wing officer (wing commander), group officer (group captain) and air commandant (air commodore).

Generally speaking, the age for membershp of the W.A.A.F. is 18 to 43, but there are exceptions in the case of women who served in the last war (maximum age, 50), for cooks (18–47), special duties clerks (18–35), administrative airwomen (21–43), radio operators (18–35), and sick quarter attendants (23–43). Pay varies between 1s. 8d. a day, including 4d. a day war pay, and 7s. a day for a senior sergeant. From time to time the age limits for various occupations are varied to keep pace with the demand, so that some of the age groups given may have been modified since this was written.

At the outset there were only five trades open to members of the W.A.A.F.; now there are twenty-six. Today, women are trained as instrument mechanics, wireless telegraphy slip-readers and operators, sparking plug testers, wireless operators, cooks, fabric workers

(aero) and fabric workers (balloon), equipment assistants; for administrative duties and for various clerical duties; as teleprinter operators, radio operators and tracers, telephone operators, four kinds of aircraft hands, dental clerk orderlies, and sick-quarter attendants.

Some of the R.A.F. doctors are women but they do not form part of the W.A.A.F.; nor do the nurses, who come under the separate organization already referred to—the Princess Mary's R.A.F. Nursing Service.

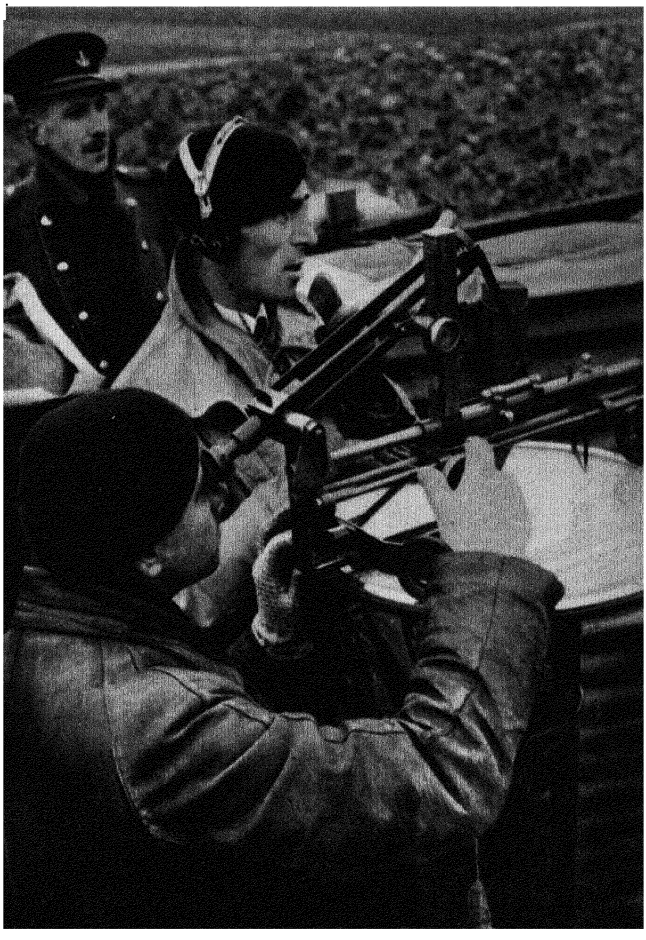
Women who have been upholsterers, machinists or tailoresses are found to be good at fabric work, while those who have had experience in factories or wireless shops usually make excellent instrument mechanics. Women who want to become wireless-telegraphy slip-reader operators must be experienced typists (preferably touch-typists), while general duties clerks must be able to type at a minimum rate of thirty words a minute. Commercial artists are among those employed as tracers, whose job it is to trace in and colour maps. Some women are engaged in tracking enemy aircraft operating over this country, and in this responsible occupation they work in close touch with the Royal Observer Corps.

A new school for code and cypher officers of the W.A.A.F. was opened in 1940. It is in a big country house in one of the royal counties of England, and is the first of its kind in the Service. The school is actually administered by the Technical Training Command of the R.A.F. W.A.A.F. officers take a short course, which is on the lines of that at the Royal Air Force Staff College. When that course has been completed the officers are posted to

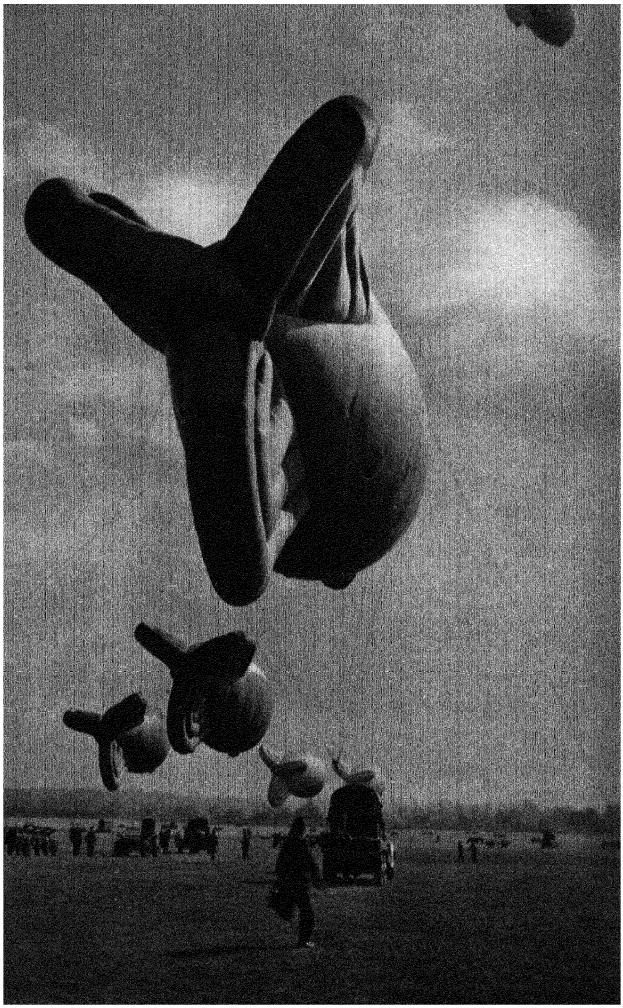
an R.A.F. unit, and in addition to their code and cypher duties they are then responsible, in conjunction with the administrative W.A.A.F. officers, for the welfare and recreation of the airwomen attached to the unit.

It is the aim of the authorities to enable women, while they are serving in the Women's Auxiliary Air Force, to equip themselves for a return to civilian life after the war, and so an educational course has been prepared with great care. Many of the younger women interrupted careers to take up this work of national importance, and they can continue their studies without any cost to themselves. Quite a number are learning foreign languages, particularly French and German, while some are training to be book-keepers and shorthand-typists. The women are also given talks at the stations on current events to encourage them to take an intelligent interest in what is going on in other countries. Many members of the Force are from the Dominions and Colonies; some are nationals of friendly neutral countries.

Since the war started quite a number of the W.A.A.F. have won decorations for bravery. A very few illustrations of the sort of deeds for which those decorations have been awarded will suffice to show the high standard of courage which the women have displayed under fire. A sergeant was in charge of a telephone switchboard which, for some extraordinary reason, was situated in the station armoury. The switchboard linked all the defence posts around the station, and if the attackers were to be kept at bay it was vital that the telephones should be kept working. While bombs were falling all around, this brave woman stayed,



THE ROYAL OBSERVER CORPS AT WORK



THE BALLOONS GO UP

surrounded by enough high-explosives to blow her to pieces, and maintained contact with all the posts. As soon as the enemy aircraft had been driven off she snatched up a bundle of red flags and marked the places where unexploded bombs had fallen. For this act she was decorated with the Military Medal.

A woman corporal stationed at a bomber aerodrome saw a British machine crash on the landing ground and burst into flames. She knew that there was great danger of the bomb cargo exploding at any moment, but, with no thought for her own safety, she rushed to the blazing aircraft and pulled out the members of the crew, dragging them to safety in the nick of time. She, too, won the M.M.

Just one more illustration: A corporal cook was in a dug-out which received a direct hit during a particularly severe raid on an R.A.F. fighter station. Several airmen were killed and others injured, while some were pinned under the wreckage of the shelter. The dugout was quickly filled with smoke and fumes, but the airwoman went to the assistance of the wounded men, gave first-aid and then fetched a stretcher, staying with the men until they could be got out. The *London Gazette* announcing the award of the M.M. said that she "displayed courage and coolness of a very high order in a position of extreme danger."

When women can display such bravery in moments of great danger it is not surprising to find an R.A.F. station commander, after a heavy attack on his aerodrome, sending a telegram to the Director of the W.A.A.F. in which he said that the women's calm courage was "a fine example to the whole Service."

CHAPTER TEN

HEALTH AND HAPPINESS

ALL the Commands of the R.A.F. have now been described. It will be quite obvious to the reader that, with such a vast field to cover, there must be some central organization responsible for the welfare of the hundreds of thousands of men—and women—who are wearing blue in war-time.

To assist men of all ranks of the Service and their relatives who, through ill-health, unemployment or some other cause, may find themselves in financial need, there exists a permanent body known as the Royal Air Force Benevolent Fund, which has its temporary war-time headquarters at Eaton House, Eaton Road, Hove, Sussex. This fund has done excellent work for many years and the calls made upon it in such times as these are very heavy indeed. If anyone wants to express his or her gratitude to the men who have fought so valiantly against the *Luftwaffe* no better way could be found than to send a donation to the Fund. Early in the war Lord Nuffield generously gave £250,000, and it has been put to excellent use.

But even where no financial difficulties exist men forced to spend their lives away from home, often miles from a town, need to be well looked after. Therefore

there is a Welfare Branch of the Air Ministry whose job it is to coordinate the work of the vast network of voluntary and other organizations which administer to the spiritual and bodily needs of the R.A.F. personnel and provide for their entertainment and relaxation. Though these bodies embrace such widely separated problems as education, entertainment, fitness, physical health and training, comfort, feeding and morale, the unified direction prevents any overlapping, so that the essential part which each plays dovetails into a nation-wide scheme which functions wherever Royal Air Force units are to be found.

Entertainment is a matter which has been gone into thoroughly, for the authorities realize that it is closely bound up with the whole question of morale. Men stationed on an aerodrome miles from anywhere who have nothing to do in their leisure time are apt to get "browned off," as they would express it, and men who are constantly fed up are not likely to give of their best or to stand up well to air attack. On most of the big R.A.F. establishments throughout the country there is a cinema, a concert hall and a swimming pool, as well as recreation rooms where one may find every known indoor game or pastime from darts to billiards.

ENSA has become a sort of semi-official body for the entertainment of the troops and airmen, and each year it provides many thousands of concerts and other stage performances, in some of which the most famous artistes have appeared. For the smaller stations there are regular visits from touring shows and travelling cinemas, while

the R.A.F. Director of Music organizes extensive tours for the three R.A.F. bands, all of which are made up of skilled musicians. Members of famous peace-time dance bands also visit the stations.

Some of the R.A.F. units have their own dance bands and orchestras; others go in for whist drives and dramatic and debating societies. Probably no section of the community is better catered for in this direction than the R.A.F.

Because the Air Ministry realizes its great importance at any time, and especially under war conditions, special attention has also been devoted to the question of physical fitness. This is not dismissed lightly as being merely a matter of physical jerks and drill, boxing, football, cricket and cross-country running. It has been studied scientifically, so that a more accurate description would be physical education. Several hundred instructors have now been appointed and more are constantly being trained. These men not only teach physical fitness in all its aspects but they study the men's reactions to fatigue and prescribe and provide the best remedies. They also watch the effect of health on morale. (This is, of course, a matter in which the Service doctors collaborate.)

Every officer responsible for watching the interests of R.A.F. men—and that means nearly every one—received some time ago a booklet containing common-sense hints on the important subjects of discipline, morale, physical fitness and efficiency. One passage in it reads:

"The civilian population will look to Service personnel to set an example of courage and leadership.

> . . . There is no branch of the Services where morale is more important than in the R.A.F. The nature of the job calls for the highest standard of physical fitness, and the situations likely to develop call for the highest and best type of morale."

Sport naturally plays a big part in the physical fitness campaign, and there is hardly a popular outdoor or indoor game which cannot be played. A central fund is available to assist with the purchase of "togs" and equipment, while the R.A.F. Comforts Fund supplies the smaller units which have no funds of their own. Incidentally, the Comforts Fund also makes free issues of such useful things as gramophones, wireless sets, books, pianos and woollens, like scarves, mittens, Balaclava helmets, socks and stockings. The author can say from experience how welcome these things were to the men of the Advanced Air Striking Force and the Air Component during the exceptionally cold 1939–40 winter in France, and no doubt they were equally acceptable to the men stationed at home.

No R.A.F. station would be complete without its N.A.A.F.I. (Navy, Army and Air Force Institute). These stores do not aim at making a profit; they are run for the benefit and convenience of the men. In these huts it is possible to buy everything from cigarettes to button polish—and usually even chocolate.

Each station has its welfare committee, which works closely with the voluntary organizations operating on the spot. What may be termed the social services are carried on by the Council of Voluntary War Work, of which

Lieutenant-General Sir John Brown is chairman. Working with the Council are such bodies as the Y.M.C.A., Y.W.C.A., Toc H, Church of Scotland, Salvation Army, Church Army, Catholic Women's League, and the Methodist and United Board Churches. As far as possible, one of these maintains on each station a hut where men can read, have a quiet chat, eat refreshments, write letters or play games.

Though the network of voluntary organizations function all the year round, perhaps their best and most valuable work is done in the long, dark winter months, when unsuitable weather and the long hours of night impose a certain restriction on other activities. These organisations combine not only to keep the airmen fit for their work but to help them use their leisure to the best advantage. There is, of course, no compulsion about it, but the majority of the men wisely take advantage of the facilities they are offered.

There is also a comprehensive voluntary education scheme, run on much the same lines as that for the W.A.A.F. Many of the R.A.F. stations have excellent libraries containing works on a variety of technical subjects, while a first-class series of lectures of an educational and cultural nature has been arranged by the Director of Education. The British Council also gives valuable assistance on the educational side.

Thanks to the willing co-operation of the ever-generous British civilian population, pilots and flying crews who are tired and a bit worn after a period of intense activity can sometimes get away for a few days' quiet and rest

at a country house in some part of the country where air raids are few and far between. Many of the angling societies have arranged that any member of the three fighting Services can fish in their private waters; dozens of golf clubs have thrown their courses open; while football, hockey, and cricket clubs willingly lend their grounds for matches.

Another relaxation scheme, which has been worked out in collaboration with the Ministry of Aircraft Production and the Society of British Aircraft Constructors, permits an interchange of visits by flying personnel to factories and of the craftsmen to the operational stations. Bomber crews may visit a Whitley factory, a munitions factory where the bombs which they carry are made, a radio factory, or some other workshop engaged in the production of some part of the bomber's equipment. There they tell the workpeople about some of the adventures which have befallen the aeroplanes they helped to make, where and how they have dropped their bombs; or perhaps they will be able to give a first-hand account of how the compass made in that factory brought them home from a raid in trying weather.

At other times men from a Spitfire factory may be taken to a Fighter Command station, where they can chat with the pilots. In this way a closer and deeper understanding and sympathy for the problems of the other have been created. Pilots' visits to factories have also had a noticeable effect on production, while the craftsmen can discuss technical problems with the men who have to handle their products.

As one would expect, the R.A.F. medical services are as efficient and up-to-date as could be found anywhere in the world. Each squadron has its own M.O., while specialist treatment is readily available for men of all ranks.

Organized games play an important part in the recovery of pilots and crews who have been wounded or injured. The more serious cases are treated at a hospital which was formerly a luxury hotel and which is situated among rolling pine woods overlooking the sea. The object of the games is to re-educate muscles and joints, to help fractured limbs to become strong and pliable again; and to counteract the nervous strain inevitably associated with operational flying. In plaster of paris limbs tend to become stiff and muscles to waste away. The games are designed not only to restore normal movement but to avoid the monotony of doing what would otherwise be tedious exercises.

Boredom is one of the worst enemies of recovery, and no trouble or expense is spared to eliminate it. Facilities are provided for such games as table tennis, quoits and darts. It seems that striving for the "double 20" on a dart board is a good way of remedying stiffness in the arm. Swimming is also encouraged, while those who are fit enough may play lawn tennis or squash racquets.

The British Red Cross Society has equipped a large library in the hospital, while a staff of voluntary workers give advice and instruction in various arts and crafts. The hospital has six operating theatres. There is also a large electro-therapeutic department and a portable electro-therapeutic set, which provides infra-red and ultra-violet

rays in addition to radiant heat and short-wave treatment.

For men fighting in the heat and sand of North Africa a rest house, appropriately called "Hurricane House," has been opened in Cairo. It was instituted by Air Chief Marshal Sir Arthur Longmore, then Commander-in-Chief of the R.A.F. in the Middle East. The house stands in the main shopping thoroughfare of the city, and the gardens surrounding it are planted with as much grass as possible, for the green is restful to the eyes of men who have been squinting for weeks in the sun-glare over the desert. There are similar rest houses in other parts of the Empire.

At many of the home stations one of the most popular diversions among the flying crews is gardening. It is not only good exercise and a complete change from the strain of flying but is helping to make many of the stations completely self-supporting in the matter of vegetables and fruit. (Incidentally, some of the stations go in for pig-breeding as well.) So much importance is attached to cultivation for all these reasons that in April, 1941, the Air Council appointed Mr. A. H. Whyte, County Horticultural Adviser to the Shropshire County Council, as Air Ministry Gardening Officer.

The R.A.F. recently started their own magazine, a bright and breezy weekly publication called *Contact*. The publication of Volume 1 coincided with the twenty-third anniversary of the formation of the R.A.F. *Contact* is written and produced by airmen for airmen and has proved very popular indeed.

Many more facilities could be mentioned, but enough has been written to show that in all branches of welfare

the R.A.F. is catered for adequately and even elaborately. Few people will doubt that the existence of this comprehensive network of organizations, covering every branch of Air Force activities, has made an important contribution to the efficiency of the Service as a whole.

CHAPTER ELEVEN

EMPIRE RESERVOIR

THE man who conceived the idea of creating an Empire Air Training Scheme was nothing short of a genius, and his foresight may go a long way towards winning the war in the air.

Once factories have been built and jigs made, aircraft production is merely a matter of keeping at it grimly, but pilots and flying crews must have individual and thorough training covering many months, so that in a long war it is in men and not in machines that a bottle-neck is likely.

The Empire Air Training Scheme in Canada—by far the biggest part of the plan—started operations in May, 1939, with the object of providing 20,000 pilots and 30,000 air crews each year. The full output was expected to be reached by the end of 1941, but such excellent progress has been made that "full steam ahead" is now anticipated by September, 1941.

Some idea of the magnitude of the scheme may be gained from a study of the expenditure. In 1940 it was estimated that the cost over a period of three years would be 607,000,000 Canadian dollars, which would be met as follows: United Kingdom, 185,000,000 dollars; Canada, 353,000,000; Australia, 44,000,000; and New Zealand, 28,000,000 Canadian dollars. Canada was to bear the

initial cost and would then be reimbursed by Britain, Australia and New Zealand on the basis of the number of airmen trained under the scheme. That was in 1940. In March, 1941, amended estimates were pubished. The total cost was then put at about 1,000,000,000 Canadian dollars (£225,000,000) of which the Canadian share would be 853,000,000 dollars. In addition, millions of dollars have been spent for schools in Canada outside the scheme, which are occupied by British and other airmen.

A total of 115 training establishments in the Dominion was planned, including 26 elementary flying schools, 16 Service flying schools, 10 observer schools, 10 bombing and gunnery schools, 3 initial training schools, 4 wireless schools, and 2 air navigation schools. There are also schools where ground crews are trained. The vast majority of these establishments have been working to capacity for some months, as well as 4 manning pools, 1 central flying school, 1 air armament school, 1 motor-boat school, 1 equipment and accounting school, 1 aircraft inspectors' school, 1 school of aeronautical engineering, and 1 technical training school.

At the head of this vast scheme is Air Marshal W. A. ("Billy") Bishop, V.C., one of the most famous pilots of all time. During the last war Bishop was officially credited with the destruction of seventy-two Hun aircraft, and he won practically every decoration open to an airman. In April, 1917, he was awarded the Military Cross for shooting down an observation balloon and a scout aeroplane, and in June of that year his exploits gained him the D.S.O. His Victoria Cross was won by one of the most

daring feats of the war. He crossed the German lines single-handed and attacked an aerodrome twelve miles behind them. Three aircraft were sent up to tackle him and he shot them down one after another. Bishop still holds a pilot's licence. What better man could be placed in charge of a scheme to produce thousands of men who are eager to emulate his great achievements in the air?

One of the obvious advantages of the Canadian scheme is that it enables pilots and flying crews to be well away from the danger and interruption of enemy air attacks. Another, which is perhaps almost equally important, is that the vast space of Canada enables adequate flying training to be carried on throughout the year. One of the bugbears of training flying men in this country is that their course is often held up for weeks at a time because the weather is unsuitable. Even during the Canadian winter flying can continue uninterrupted, for the skies are clear and the authorities have discovered a means of compacting the snow on the aerodromes, providing excellent runways. And on top of these advantages is the cheering fact that black-out is unknown in the Dominion.

Realizing that time is precious, those responsible for administering the scheme in Canada have worked out plans for utilizing every minute of the day, so that from dawn to dusk the sky near the flying training schools is filled with a constant hum of engines. At No. 1 Bombing and Gunnery School at Jarvis, Ontario, what is known as "chain flying" has been introduced. Maintenance crews have been so well trained that an aircraft is on the ground

only seven minutes between flights. All day long the Fairey Battle aircraft are landing and taking off, and while the fuel tanks are being refilled one crew is climbing out and returning to the hangars and another takes its place. Flying continues uninterrupted throughout the lunch hour.

Crumlin Airport at London, Ontario, houses Fleet Finch primary trainers. One side of the aerodrome forms No. 3 Flying Training School, while the other side is No. 4 Air Observers' School, where Avro Ansons are used. Some of the instructors here are Americans. There is another Bombing and Gunnery School at Fingal, which favours Battles, while at No. 6 Flying Training School at Dunnville, Ontario, the trainers are North American Harvards and Yales.

There are mass concentrations of men as well as machines in Central and Western Ontario. No. 1 Manning Depôt, in the Coliseum Building at the Canadian National Exhibition grounds in Toronto, is a receiving centre for thousands of new recruits. More thousands of men are centred at the Technical Training School at St. Thomas, Ontario, where a mixture of mechanics, fabric workers, instrument makers and parachute packers are turned out. The brand new £1,500,000 Ontario Mental Hospital buildings are used as living quarters. In the large hangars at the rear of these buildings hundreds of airframe mechanics (called riggers in this country) are being trained, while in another hangar young men are being initiated into the mysteries of such aero-engines as the Rolls-Royce Merlin and the Bristol Pegasus.

The Dominion Air Minister, Mr C. G. Power, stated early in 1941 that Canada was outstripping the United States in producing trained air crews and was emerging as the fourth air Power in the world. The number of men who have already graduated from the scheme is, of course, a closely guarded secret. It is no secret, however, that an ever-increasing flow of trained men from all parts of the Empire are arriving in this country from Canada to carry on the grim fight in the air. The nearest figure quoted by the Minister was that at that time there were 10,000 students enrolled and that from 15,000 to 20,000 more would be enrolled as air crews during 1941. When all the schools were in operation, he added, the staff would number more than 40,000. The total number of students to be trained in Canada would not be far short of double the figure visualized a year previously.

It is small wonder, then, that in his 1941 Air Estimates speech Sir Archibald Sinclair described the success of the Empire Training Scheme as having "passed all expectations" and was able to reveal that men trained under it were already flying daily against the enemy.

When Captain Harold Balfour, M.P., Parliamentary Under-Secretary of State for Air, returned from a tour of inspection in Canada at the beginning of 1941 he was loud in his praise of what he had seen. The layout of aerodromes was excellent, he said, the keynote being simplicity, adequacy, and labour-saving machinery for men and equipment.

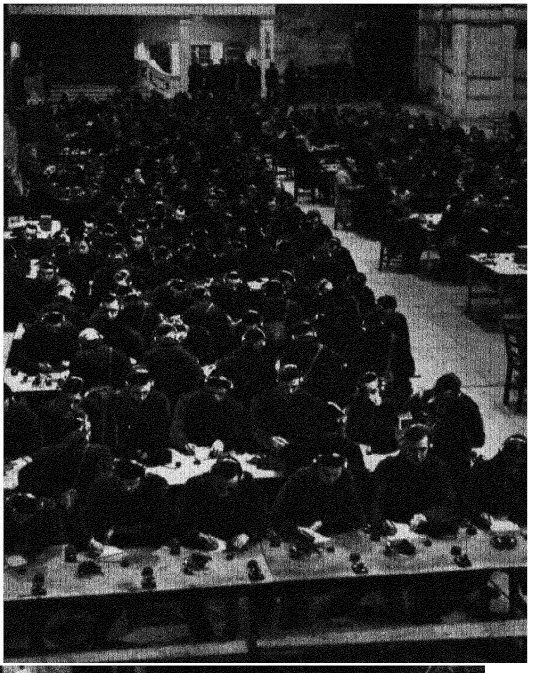
Australian and New Zealand pilots and crews who receive *ab initio* training in their home countries go to

Canada for their final stages. The number making the long journey grew so rapidly that the embarkation depôts at Sydney and Melbourne became unable to cope with them and a third depôt had to be opened at Adelaide. Some of the men who pass through these points (known as "bed and breakfast units") are fully trained and are being sent as replacements or reinforcements for the Royal Australian Air Force squadrons already on active service. Most of the arrivals are air crews, but all Air Force trades are represented, including motor-boat crews, wireless operators, office orderlies, cooks, drivers, Service police and electricians. Similar depôts to the new one at Adelaide will be formed in other States in the Commonwealth if and when the necessity arises.

Well before the end of 1940 nearly 100,000 applications had been received in Australia to join the Empire Scheme, and at Christmas of that year the first fully-trained Australian pilots arrived in England. They had done their elementary and intermediate training in their own country and "finished off" in Canada. At the time of their arrival it was stated officially that more than 40,000 men had been enlisted in the Commonwealth for service under the Empire Scheme, out of 140,000 applicants. In addition to training schools in various States, Australia has an elementary flying school at Launceston, Tasmania.

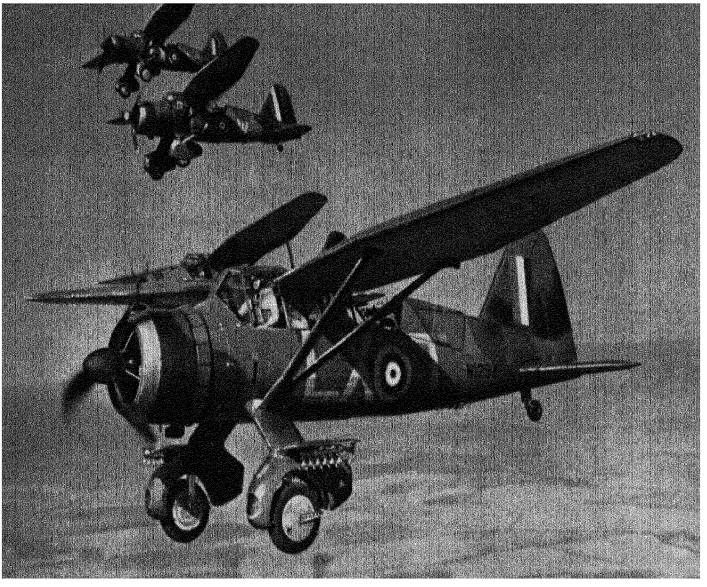
New Zealand's contribution, when working at full capacity will provide 3,700 trained men a year. Whether that figure has yet been reached the author is unable to say. More than 4,000 trainees had been registered by the autumn of 1940, while by the end of that year New

TRAINING WIRELESS OPERATORS FOR THE R.A.F.





W.A.A.F. PERSONNEL BEING REVIEWED



SPATTED LYSANDERS ON PATROL

Zealand had sent approximately 1,500 pilots, observers and air-gunners to Britain and Canada for advanced training.

Southern Rhodesia's part of the Empire Training Scheme, working fully, is producing 1,800 pilots, 240 observers and 340 air-gunners a year.

Newfoundland is contributing pilots, observers and wireless operator-air gunners to the Canadian part of the Empire Scheme. The first group were enrolled by a Royal Canadian Air Force recruiting detachment.

In addition to the large-scale schemes, the Colonial Governments in Malaya, Trinidad and Bermuda have themselves devised plans for giving elementary flying training. The Air Ministry gratefully accepted an offer by the Trinidad Flying Club to train pilots for the R.A.F. and the local Government agreed to bear the cost.

South Africa has a training scheme of its own which is producing excellent results. The trained men do not join the R.A.F. but the South African Air Force, which has done so splendidly in the air fighting in the Middle East.

A substantial training organization has been formed in India to turn out pilots for the R.A.F. in India and for the Indian Air Force. Burma has also established a flying training organization. The first Indian flying officers to reach this country, who were entertained to tea by the King, were all experienced civil pilots. One had nearly three thousand hours to his credit, including flights between England and India and England and the Cape.

Under the Overseas Recruiting Scheme British subjects who volunteer for air crew duties are provided with free passage home. From all parts of the Empire men are

hurrying back to offer their services. Four friends, all of whom had had flying experience, travelled to England together from the Bahamas. A Scotsman, normally resident in Patagonia, rode hundreds of miles on horseback to catch a ship for England from Buenos Aires. A great many have returned from different parts of the Argentine. One journeyed eight hundred miles overland across South America to his port of sailing. More Britons have come from Honolulu, Venezuela, Cuba, the Leeward Islands, Bermuda, Trinidad, the Seychelles Islands, Mauritius, Peru and many other places.

Such a spirit leaves no room for doubting the determination of British men in all parts of the world to play their part in driving the *Luftwaffe* from the skies.

CHAPTER TWELVE

RESERVOIR JUNIOR

For speed of growth the only thing that could compare with the Air Training Corps is a prairie fire. Formed on April 1, 1941, in five weeks 1,051 squadrons had been formed in every part of the United Kingdom and by the end of April the total of squadrons was not far below 1,500.

Its purpose is to provide boys between the ages of 16 and 18 with basic training which will be of value to them when they reach the minimum age for joining the Royal Air Force—18—and to bring up to the required educational and physical standard boys who would not otherwise have been able to attain them. In other words it is a long-term training scheme designed to ensure a flow of pilots and flying crews of the right type, not only for the R.A.F. but for the Fleet Air Arm.

The popular appeal of the R,A.F. to the youth of the country is shown by the fact that the number who have already joined the A.T.C. stands at roughly 200,000 out of a total of only 750,000 boys between these ages in the whole country. It augurs well for the future of our Air Force.

Fortunately, when the scheme was introduced it was not necessary to set up completely new machinery,

because for some years there had existed a national organization known as the Air Defence Cadet Corps which, though not an official body, had the Air Ministry's blessing, having as it did much the same aims as the proposed new Corps. It possessed an efficient headquarters staff administering about two hundred squadrons of boys spread over the whole country. For some time the future status of the A.D.C.C. had been under consideration by the Air Ministry, and in December, 1940, Captain Balfour stated in Parliament that proposals to make use of its resources were being discussed. Up to that time the Air Ministry had given the Corps only limited support. It provided certain materials for the boys' training; each cadet squadron was attached to an R.A.F. unit; instructors from R.A.F. stations gave the boys lectures, and they in return gave what help they could on the aerodromes. The only financial assistance provided by the Government was a grant of 3s. 6d. a head for boys who were "on the strength" six months before the outbreak of war. The annual cost of running a cadet squadron varied between £200 and £400 a year, so that the funds had been found very largely from local sources.

In the middle of January, 1941, the Air Minister announced plans for the new Air Training Corps. The scheme was divided into three parts. Units were to be formed at the universities, at public and secondary schools, and locally. At the universities the Air Ministry was arranging a six months' course for youths who wished to serve as pilots or navigators and who were regarded as potential candidates for commissioned rank. While at the

universities the young men would join the 'varsity air squadrons and would carry out a course of instruction in Service subjects similar to those taken at the initial training wings of the R.A.F. Flying Training Command. At the same time they would pursue a course of study given by the teaching staff of the university in subjects of value from the Service point of view, such as mathematics and mechanics, electricity and magnetism, engineering, meteorology and navigation. All selected candidates were required to take the first of these and one of the other four subjects.

Arrangements had been made whereby boys would be full members of the university while taking the course. Selected candidates would be attested for the R.A.F. before going into residence but would be placed on deferred service during this period. All expenses, except such personal ones as for laundry, were to be paid by the Air Ministry, but the young men would not draw Service pay. On completion of the course candidates who secured the university air squadron certificate and who satisfied the Joint Universities Recruiting Board of their diligence and progress in their other studies and who were regarded as being otherwise suitable would go direct to a flying training or observer training school. That is to say, their training at the university, having been similar to that given at the initial training wings of the R.A.F., would be substituted for the first stage of their Service training.

The first universities course started on April 15 and courses are being conducted at a number of universities in England, Scotland, Wales and Northern Ireland. The

candidates for the course at a university were chosen from public and secondary schools by R.A.F. selection boards on the basis of nominations received from headmasters.

In order to get the scheme going the Air Minister persuaded Uppingham School to release for a period of six months their brilliant headmaster, Mr J. F. Wolfenden, and he became the Air Ministry's first Director of Pre-Entry Training. The Director is directly responsible to Air Marshal A. G. R. Garrod, the Air Member for Training. Responsibility for the training of all units and for the administration of local units is vested in Air Commodore J. A. Chamier, who was formerly Commandant of the Air Defence Cadet Corps.

Naturally, the local scheme forms by far the largest part. There is no corner of the country where a unit has not been formed. It is here that the organization of the Air Defence Cadet Corps has been most useful. Where there had been a local cadet squadron the committee readily offered their services; where there had not, a local organization was set up without delay. Arrangements were made with the local authorities for instruction to be given at Air Ministry expense in such essential subjects as mathematics. Smaller schools were encouraged to link up with local units, and many have done so.

An Air Training Corps Council of Welfare was also set up, together with a small board of trustees. For potential air crew candidates the local schemes are now providing a syllabus approximating to that of an R.A.F. initial training wing. The principal subjects are mathematics, navigation, signals and the theory of flight.

Wherever possible Link trainers are being provided. Special syllabuses have also been prepared for potential entrants for mechanical and signals ground duties. In many cases schoolmasters have volunteered to act as instructors, while hundreds of men with R.A.F. experience have also come forward.

On the day after the scheme had been announced in the Press offers to form squadrons, to help with this and that, came pouring into the Air Ministry. The department was almost overwhelmed. It had expected a splendid response but had hardly anticipated a veritable flood. For days the Air Ministry Information Bureau in Kingsway was working at top pressure, while even more applications arrived by post. In the first few days the success of the Air Training Corps was assured.

On the day when the A.T.C. officially came into existence Air Commodore Chamier told Press representatives that the response had been "startling." Including the original squadrons of the A.D.C.C. two hundred and thirty local units had already been formed, while more than four thousand applications had been received from men who were anxious to offer their services as instructors or organisers. Thousands of boys had already been enrolled.

A day or so later the London County Council, which, since the Labour Party came into power, had banned cadet corps in all its schools, decided to cooperate. This decision meant that all their hundreds of schools and evening institutes would be made available for A.T.C. instruction, and it has greatly contributed to the success of the scheme in the Home Counties. Since that time more than one

hundred A.T.C. squadrons have been formed in Greater London alone—no mean achievement when one bears in mind how many families have gone to live in the provinces since the air attacks on the capital began.

It is too early yet for the results of this vast new scheme to bear fruit, but if the war drags on until 1942—and there seems every prospect of it doing so—the R.A.F. will be assured of a useful contribution to both flying and ground crews.

For those boys who are not yet old enough to join the A.T.C. the Boy Scout Movement has formed a new section, known as the Air Scouts. Boys can receive an elementary form of instruction in Service subjects, and when they attain the age of 16 they can, if they so wish, then join one of the cadet squadrons.

Should the unexpected happen and the war come to an end before any of the cadets can find their way into the R.A.F. the scheme will still have been worth while, for it will have improved the education of many boys who would otherwise have started out in life with nothing better than an elementary school knowledge and experience to help them.

CHAPTER THIRTEEN

THE FERRY PILOTS

WHEN an aircraft has been built at one of our factories or in an American or Canadian factory there remains one important task—to get it to a maintenance unit to be prepared for operations and then on to the R.A.F. squadron which will take it into action. With production on such a big scale as it is today this calls for a large number of experienced pilots which the Service itself could ill afford to spare from operations or from instructing pupils. And so the war has called into existence what is known as the ferry pilot.

All the ferry pilots are civilians; some of them are women. Many of the men were formerly employed by civil air lines, notably the old Imperial Airways and its successor, the British Overseas Airways Corporation; others were members of civilian flying clubs who gained most of their experience of aviation at week-ends. In this country the ferrying is carried out by an organization known as Air Transport Auxiliary; in the United States and Canada by a body always referred to as "Atferro," which is an abbreviation for Atlantic Ferry Organization, but on both sides of the Atlantic the delivery of aircraft is controlled by the Ministry of Aircraft Production.

Atferro is something quite new. It has sprung up since

America started to send us aircraft. It is no secret—in fact Lord Beaverbrook referred to the matter in his speech in the House of Lords in April, 1941—that some of the American aircraft destined for service with the R.A.F. never reached their destination because the ships bringing them across were sunk by the enemy either by bombs or torpedoes. Obviously, the less risk of losses *en route* the better for all concerned—except, of course, the Nazis. It might discourage the Americans in their big production effort if they could expect a big proportion of their aircraft to finish up on the bed of the Atlantic before they had even had a chance to fire a gun.

It may safely be assumed that the aircraft which were lost by enemy action were fighters, for any aeroplane with a sufficiently long range has been flown across to England ever since October, 1940. The complete machines are delivered to Canada from the United States factories, taken on to Newfoundland and then flown direct to reception depôts in this country. The success of this enterprising method of delivery has been extraordinary. Up to the time when Lord Beaverbrook made the House of Lords speech already referred to only a single aeroplane, representing a decimal of 1 per cent. of the total, had been lost. The author knows for a fact that that still held good some time later. It may still represent the sole casualty.

Yet those machines have been brought across, week after week and month after month, in weather which was often totally unsuitable for cross-ocean flights. Cast your mind back a few years to the days when only a select

few men in the whole world could claim to have flown the Atlantic and when a successful attempt was hailed as a wonderful achievement. In those days the take-off was frequently delayed for weeks and even months by unfavourable weather reports. Nobody even dreamed of setting out during the winter. Yet, without publicity or any blowing of trumpets, here was this gallant band of civilians not only getting across safely with valuable aircraft but actually breaking records—without breathing a word about it. It was a glorious achievement, and it is still continuing, continuing on an ever-increasing scale.

When war overtook this country the shortest time for a flight across the Atlantic was 10 hours 33 minutes, set up in September, 1937, by the Imperial Airways flying-boat *Cambria* during an experimental flight from Botwood, Newfoundland, to Foynes, in Eire. Atferro had not been functioning very long before a British ex-civil air line pilot brought the record down by nearly an hour, while in the spring of 1941 some of the American bombers were getting over in $8\frac{3}{4}$ hours. And, remember, they could not come down at Foynes. One has actually crossed in the almost unbelievably short time of $7\frac{1}{2}$ hours.

Among the American aircraft which have been brought over in this way are the Consolidated P.B.Y. flying-boat, known in this country as the Catalina; the Boeing B-24 heavy bomber (British name, the Liberator); the Lockheed Hudson and Lockheed Viga Ventura; and the Boeing B-17 (the "Flying Fortress"). All five are excellent aircraft, with the Catalina one of the finest of its type ever produced.

Sometimes the uneventfulness of their flight over the vast stretch of water is broken by the sighting of a German U-boat. When the powerful bomber swoops down on it the submarine crash-dives in a swirl of foam and spray. Sometimes the ferry pilots have spotted survivors from a torpedoed British ship, gamely pulling along in their little boats, hundreds of miles from the nearest land. On more than one occasion the aircraft's radio has brought timely aid to men who might otherwise have died of thirst or been drowned in the mountainous seas.

The Germans are furious at the success of the Atlantic ferry service, for it shows up the hollowness of their oft-repeated statements that American aid for the R.A.F. has come too late and that these islands are virtually cut off from the rest of the world. They would have liked the world to believe that their Condors and Kuriers were in command of the air over the Atlantic, at any rate near the approaches to Britain. For months their propagandists were telling everyone who would read or listen that we were giving up the idea because it had proved too expensive. They would like to believe it was true.

The delivery of American bombers and flying-boats, then, presents no difficulties. But how about the fighters? They haven't anything like a sufficient range to fly across non-stop. Lord Beaverbrook must have gladdened many hearts when he was able to announce that preparations were in hand for bringing fighters as well by air. Obviously they must be coming by a different route, but what that route is let the Germans find out for themselves.

So much for the Atlantic ferrying.

The way in which Air Transport Auxiliary came to take over the delivery of British-made aircraft is a strange, almost romantic, story. Though it is doing the job with conspicuous (or perhaps one should say inconspicuous success, for it works "behind the scenes"), A.T.A. was never intended to ferry at all. Shortly before the outbreak of war Sir Francis Shelmerdine, Director-General of Civil Aviation, worked out a plan for using aircraft to replace land communications which might be put out of action by enemy action. For that purpose a number of experienced civil pilots were recruited for general air communications work.

But the "phony" war got well under way and still the anticipated German attacks on Britain did not come. Meanwhile, the A.T.A. pilots were kicking their heels with little or nothing to do, and, to borrow an R.A.F. expression, they were getting "browned off." During the autumn of 1940 the R.A.F. asked for the loan of a few civilian pilots to ferry the new aircraft from the production line to the squadrons. The Air Transport Auxiliary men jumped at the chance of doing some useful work. They did it so well that they have been doing it ever since.

A.T.A. started as a small concern. (In those days our production of aircraft was such a little trickle that it didn't need to be big.) But as the numbers of British bombers, fighters and trainers grew, the ferry organization had perforce to grow with it. More pilots had to be called in, some of them "week-end fliers" whose experience was confined to light aircraft. Accordingly a con-

version course was arranged and the men were afterwards sent out to two R.A.F. "pools."

Throughout that bitter winter of 1939–40 A.T.A. carried on doggedly with its exacting work. The pilots had to be adaptable, for they never knew whether on the morrow they would be flying a heavy bomber or an elementary trainer such as a Puss Moth. The membership of each "pool" gradually expanded until forty or fifty civilian pilots were employed full-time. Still their numbers proved inadequate.

Early in 1940 Mr Gerald d'Erlanger, of British Airways, was given permission to take his A.T.A. pilots away from the Service "pools" and form a separate "pool" under his own command. The men pilots were now joined by women—the late Miss Amy Johnson among them—and until May of that year A.T.A. was concerned very largely with clearing the factories around London. When the fighting flared up in France there was a sudden urgent call for its pilots to help in ferrying machines, stores and equipment across the Channel. Unarmed, they flew day after day to Amiens, where there was an aerodrome under the control of the R.A.F. Air Component, and to Rheims, headquarters of the R.A.F. Advanced Air Striking Force. They came and went in any weather and regardless of German attacks. A little later, when telephonic communication between France and England was cut by the rapid German advance across Northern France, they also carried secret despatches to and from London. Their work was of the highest value.

Soon the "pool" near London became so big that it

had to split up into three, and the factories in all parts of the country became its "customers." The ranks were reinforced by more civil air line pilots lent by British Airways, while soon Empire, American, Dutch, Spanish, Polish and other nations were recruited for ferrying duties. In August, 1940, A.T.A. was given the additional responsibility of ferrying to and from the maintenance units, where radio, bomb-racks, armament and incidental equipment are fitted, and so on to the operational squadrons.

Even these large reinforcements gradually proved inadequate. The number of pools had to be increased until they numbered about a dozen and even more pilots were brought in. The women of A.T.A. stuck to their heavy task like heroines. (They are, of course, the only members of the fair sex allowed to fly in this country during wartime.) Today, Air Transport Auxiliary is not only a huge organization but it is doing a job which is essential for the success of the R.A.F.

Each night its Central Control receives from the Ministry of Aircraft Production a list of the aircraft to be ferried the next day. It may be six bombers and two fighters from Puddlecombe-on-Sea to Tiddlecombe-on-Mud, or it may be three trainers and one reconnaissance aircraft from London to Edinburgh. All these orders have to be considered in the light not only of the actual ferry duties but of the journey which the pilot must first make to collect the new aircraft and to return to his (or her) base after the job has been done. The journey may involve flying hundreds of miles, for the factories, maintenance

units and squadrons are scattered throughout the length and breadth of the country. It is not at all uncommon for a ferry pilot to cover anything up to one thousand miles in a single day.

The working day at each "pool" starts soon after dawn. Orders are transmitted by loud-speaker to the pilots' room, which looks very much like the fighter pilots' hut, except that it is occupied by civilian fliers wearing a dark blue uniform almost identical with that of Imperial Airways. On hearing his name called the pilot goes to the duty room to collect a "chit," or delivery slip, which is prepared in triplicate. Next he goes to the store to draw a parachute, and then, in company with several others, he is taken to his starting-point in an air "taxi," usually an Anson or an Oxford, the pilot of which is not infrequently a woman. One by one the pilots are dropped at their pick-up stations and then their working day really begins.

The way in which these civilians have adapted themselves to flying Service types is nothing short of a miracle. Today they may be expected to deliver safely a fast fighter; tomorrow it may be a heavy long-range bomber or a trainer. As an official of British Airways said: "It is like taking a bunch of suburban motorists to Brooklands and pitting them against famous racing motorists, only to find that they can hold their own with the best."

Flying at any time is a pretty tiring business for the person at the controls, but under war conditions it is full of pitfalls. The ferry pilot must keep clear of prohibited areas or he may be shot at by some lynx-eyed anti-aircraft

gunner; he must be wary of balloon barrages and other devices intended to confuse enemy machines; he must be ready at all times to give recognition signals; he must fly in any old kind of weather without the navigational aids to which he has been accustomed in peace time; and he must find an aerodrome or a building which has been camouflaged for the very purpose of being rendered inconspicuous.

Most of the men doing this trying but invaluable work are past the age when they would be accepted for operational duties by the R.A.F. They proudly, if inaccurately, refer to themselves as "Ancient and Tattered Airmen," as though that was what the initials A.T.A. stood for. A number of these fliers—Amy Johnson among them—have given their lives in carrying out this work.

The nation should be grateful to every one of this gallant band of A.T.A. and "Atferro," for they are as much "on active service" as any R.A.F. pilot.

CHAPTER FOURTEEN

OUR EYES AND EARS

No organization or body of men in the country—Service and civilian alike—could make greater claim to have displayed foresight than the Royal Observer Corps, for when the very word "war" was unpopular, when their activities were frowned upon and they were regarded almost as freaks, they kept steadily on, preparing for the time when they would be called upon to perform a vital task in defence of the whole nation.

With the entire population now keyed up to war pitch it is difficult to realize that it was only a few years ago that anyone who admitted that he trained to be able to identify different types of aircraft was regarded as being slightly abnormal; as a man who had failed to grow up and who still liked to play at games which should have been left behind with the donning of long trousers. Yet that was the case. Not long before war started their activities were either frowned on as something not quite in the best taste or were smiled at with the superior intolerance of grown-ups for adolescent pastimes. Heaven alone knows where we should have been today had this fine band of men been sufficiently thin-skinned to take any notice of the attitude of others.

Not only is the Royal Observer Corps an essential part

of our defence against air attack but in one respect it is our first line of defence, for an early warning of the enemy's approach is almost invariably given by one of the watchers near the coast.

The Corps is entirely civilian, but contradictory as it may seem, it is administered by the Air Ministry and is under the operational control of the Air Officer Commanding-in-Chief the R.A.F. Fighter Command. In addition it has its own nation-wide machinery. Great Britain and Northern Ireland is divided into areas, each with its control centre, and the control centres receive the reports of air activity observed from the posts. Each post is in direct telephonic communication with the area centre, which, in turn, is linked, directly or indirectly, with the R.A.F. fighters, the anti-aircraft guns, searchlights, balloons, police and fire brigades.

The observers at the posts report any aircraft which they see, irrespective of whether it is enemy or friendly. Directly they see or hear an aeroplane they speak to the control centre, giving (if they can) its nationality, type, location, direction and height, and they follow it until it is outside their district, by which time it has almost certainly been "picked up" by another post in the vicinity. In this way it is possible to trace the aeroplane to its destination, and, in the case of an enemy machine, to follow it until it flies out over the sea again or is shot down. The posts are also invaluable during raids because they can quickly spot fires or damage caused by high-explosives.

The watchers who man the posts come into two

categories—"A" and "B" members—but all of them, like the staffs at the centres, are volunteers. The "A" members are employed full-time, doing a 48-hour week, while the "B" members devote up to 24 hours a week of their leisure time to the work, in addition, of course, to carrying on their normal occupation. All the "B" class watchers are paid at the modest rate of 1s. 3d. an hour while actually on duty, and this sum has to cover their travelling and subsistence expenses, as well as any loss of wages their special duty may involve. The majority of the men come into this category. The Class "A" observers are paid £3 10s. a week.

Each post is supplied with maps, aircraft silhouettes, binoculars, and a special instrument to assist the crew in ascertaining the true height of an aircraft. This instrument, for which there seems to be no special name, stands on a tripod in the centre of the post: It consists of a round dial marked to correspond with a section of the larger chart at the centre. Above the dial there is a height corrector and often a telescope. The spotters work in pairs. One of them wears headphones, with a mouthpiece strapped to his chest, and he reports the movements of aircraft to the centre. The other manipulates the plotter instrument. Many of the posts also have buzzers, connected to armament factories or other places of importance in the war effort.

Immediately aircraft are spotted the information is handed on to the centre something like this: "Three Messerschmitt 110s approaching Sevenoaks at 14,000 feet, flying north-west," or it may be "Six Hurricanes circling

over Deal at 9,000 feet." Apart from the constant practice they have had since war began many of these spotters have had years of experience of identifying aircraft and they are real experts in recognizing accurately the type of machine, while their judgment of height, even without their instrument, is sometimes uncanny. Some of the newer-comers are not so reliable, but they do not often make mistakes. Many of the observers have made a study of astronomy, which helps them greatly at night.

The scene at a centre is suggestive of a giant game of halma. Most of the space is occupied by a table to which is fixed a chart showing the whole area under the centre's control. The chart is sub-divided into many small, numbered squares, each representing the area "covered" by a post. Around the table sit a number of men wearing headphones, each listening to certain posts. (The number may vary according to the size of the area.) When a post reports the presence of an enemy aircraft a counter is put into the appropriate square, and as the aircraft travels along the counter follows it on the chart. These men, called "plotters," do four-hour stretches of continuous duty. Around the room is a raised platform. Here the "tellers" sit, connected by telephone to the various defence organizations, notably the Fighter Command groups.

From a quick glance at the chart it is possible to see when an air battle is about to develop, for the position of the R.A.F. fighters as they close in on the enemy can be followed with extreme accuracy. Anyone possessed of a lively imagination could build up a mind-picture of a dramatic battle being fought out many thousands of feet

above the centre and perhaps miles from it. As the raiders pass out of the centre's area the information is handed on to the next centre, and so on until it has passed beyond our shores or has been destroyed.

In these times of large-scale raiding the centres are hives of industry throughout the night, and, in some areas, during the whole of the twenty-four hours. It is not at all uncommon for the courses of several hundred aircraft to be tracked in a few hours. Each centre keeps an accurate chart record of the activities during every quarter of an hour. By this means it will be possible, after the war, to compile a complete history of the raids on Britain from the opening of hostilities to the last day.

The spotters at the posts wear civilian clothes but have a "uniform" consisting of an armband bearing the words "Royal Observer Corps," a black beret (rather like that worn by the Royal Tank Corps), and a badge which shows the Corps' lineal descent from the Elizabethan Armada-watchers. The badge illustrates the beacons lit at the time of the Armada's approach, over which is the appropriate inscription "Forewarned is Forearmed." Soon, however, a personal issue will be made to all observers of a new pattern one-piece uniform which can be termed a "cross" between an overall and a battle-dress. The men are issued with a storm-proof coat, sou'westers and oil-skins, gumboots and steel helmets. This protective clothing is very necessary, for obviously the watcher must remain on duty throughout the worst raids and in all kinds of weather.

The officers wear a distinctive uniform with the letters

"R.O.C." in white metal, to match their buttons, on the lapel of the tunic and on the shoulder-strap of their great-coats. Recently, controllers and assistant controllers at centres were accorded officer status.

From time to time doubts have been expressed regarding the legal status of the members of the Corps, particularly of the crews at observer posts who have been issued with rifles for protection in case of attack, and it had been suggested that they might be in danger of being shot as *francs tireurs* if captured by the enemy. The entitlement of persons who bear arms to be accorded the rights and privileges of armed forces under International Law depends upon their satisfying the following conditions: (1) they must be commanded by a person responsible for his subordinates; (2) they must wear a fixed distinctive design which is recognizable at a distance; (3) they must carry arms openly; and (4) they must conduct their operations in accordance with the laws and customs of war. The Air Ministry's legal advisers have decided that all these conditions are fulfilled in the case of the Royal Observer Corps.

The Royal Observer Corps was granted permission by the King early in 1941 to use the prefix "Royal" as a recognition of its long and valuable services. The idea for such a body existed in embryo towards the end of World War No. 1, when men stood on high ground here and there in the areas which enemy aircraft were known to cross, binoculars to their eyes. If an aeroplane or a Zeppelin approached they rang up the police. Little development took place after the Armistice, however, until

1922, when a few stalwarts got together under the leadership of Major-General E. B. Ashmore, who had directed London's air defence during the 1914–18 war. By 1925 the Corps was taking shape in its present form, but because of the unpopularity of anything even remotely connected with war the members were sworn in as special constables.

By the Munich crisis week of September, 1938, there were enough trained men to have manned most of the posts. About a month before war broke out the Air Ministry gave official recognition to the Corps. In April, 1941, it gave further recognition of its value by adopting an organization called The Observer Corps Club (formerly known as the "Hearkers' Club") and giving it certain financial support to enable it to widen its activities. This organization has given valuable help in the training of observers.

There is no need to stress the great responsibility which rests upon the Royal Observer Corps. It is partly on the strength of the information, first given by the post crews and constantly received from the centres and co-ordinated by a central organization, that our fighters are sent up to intercept and engage the enemy, our gun defences are warned of the approach of raiders, and the air raid warnings are sounded in those areas over which the enemy machine, if it continues on its course, will shortly be passing.

That our fighters and anti-aircraft guns have been able to destroy thousands of German day and night marauders over and around this country is eloquent tribute to the

way in which this vital task has been discharged. It was not an over-statement when, in September, 1940, Sir Archibald Sinclair sent a message to the Corps in which he said:

> "By your vigilance and faithful devotion to duty you are making an indispensable contribution to the achievements of our fighter pilots. Their victories are your victories, too."

Information was recently made public concerning an invention, known in aviation circles for some time but not long since converted for war use. It is officially called Radiolocation which, briefly, is a system of sending out far beyond our shores ether waves which are unaffected by cloud, fog, or darkness. Any solid substance, such as an aircraft or ship, which is in the path of those waves, send back a "reflection" to the detecting station and thus reveals its presence. These waves have been on active service throughout the war and it is by this means that our defences receive the initial warning of the enemy's approach.

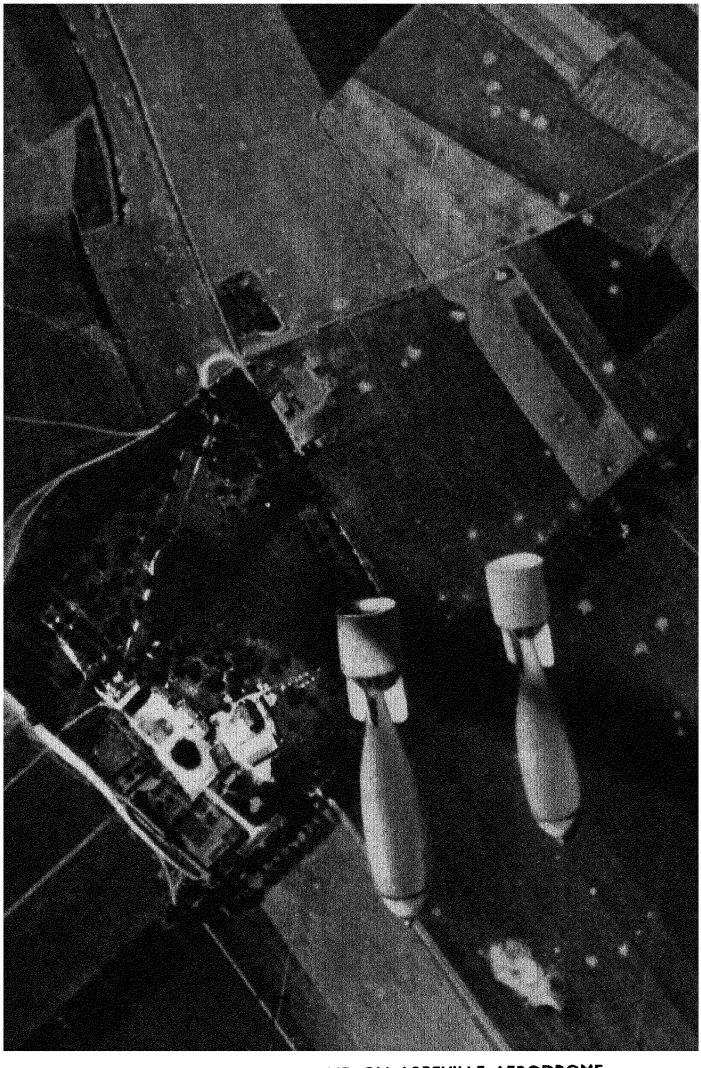
CHAPTER FIFTEEN

OTHER STALWARTS

MORE than five hundred enemy aircraft have been shot down by Britain's anti-aircraft batteries since raids on our towns commenced. And what is more, the number of rounds fired for each victim bagged is steadily decreasing. The experts say that this is due to improved methods of predication.

Since the last war the range and accuracy of our anti-aircraft guns has undoubtedly increased considerably. In those early days many thousands of rounds were fired for each German machine brought hurtling to earth; the number today is only a fraction of such a figure. Several cases have been reported of direct hits being made with the second or third shell. A Heinkel showed itself through the clouds at 8,000 feet for one brief moment and was hit first shot by a battery in the North of England.

There are different types of batteries. The "heavies" have 4.5 guns which fire at machines which are nearly always flying so high as to be out of sight. This disadvantage is partly cancelled out by the greater "field" of their shells' explosion. They can miss by nearly 100 feet and still bring down a powerful aircraft. The light guns—40 mm. Lewis and so on—fire at visible targets, either in daylight or in the searchlight beams.



A RAID ON ABBEVILLE AERODROME
Bombs on their way down



FULL-MOON RAIDERS
R.A.F. crews embark for Berlin

The predictor is a delicate mechanism, possessed of superhuman powers of finding aircraft. Highly-developed as it is, there will no doubt be further improvements from time to time. This, allied with the greater power and explosive area of the shells, will no doubt increase the guns' effectiveness still further. The difficulties of prediction are caused by the fact that allowance has to be made for so many factors: atmospheric conditions, which vary at different heights and affect the flight of the shell; tactics of enemy aircraft, which deliberately fly on a curved course; evasive action taken by enemy aircraft when they know they are near A.A. batteries (change of height, speed or course, or a combination of these).

Anti-aircraft guns are intended not only to destroy raiders but to prevent them from reaching their target by making it too "hot" for them and to prevent them from enjoying in peace the thirty seconds period necessary for laying the bomb sights on a particular target. In daytime the guns also perform a useful service by directing our fighters to the right spot by means of the puffs of their exploding shells. On a clear day these can be seen for many miles.

Anti-aircraft batteries cover the whole of the country, and the defences are carefully planned so as to give the maximum protection to the areas whose safety is most vital to our war effort. We can still do with many more guns, but time and hard work is gradually putting that matter right.

The gunners' job is hardly one that everybody would like. The battery positions are often in bleak, exposed

spots, miles from any comfort or amenities. The crews must be out in any weather which comes along; they must do most of their sleeping in the daytime. While raids are on they are in constant danger from bombing and machine-gunning attacks, and they must spend every second of their working hours constantly on the *qui vive*.

The total of enemy aircraft claimed as destroyed should not be taken as the true total. Often machines are "winged" and come down many miles away; perhaps even miles out at sea. There is no question, obviously, of being able to follow up the crippled machine to see what happens to it eventually, as can be done by a fighter pilot.

Much of what has been written about the anti-aircraft gunners applies equally to the searchlight crews. Their task is a thankless one, for they can never hope to destroy a raider, while they are particularly prone to low-flying attack.

Now just a few words about other men who do great service for the R.A.F.—the test pilots. These men have as dangerous a job as there is, for they take over new aircraft from the factories and fly them for the first time. No aircraft is passed as fit for operations until it has been put through every evolution on the ground and in the air which it may be called upon to perform during active service. Needless to say, test pilots are without exception men of great experience, the tip-top members of their profession.

Scientists and technicians, too, are vitally necessary to the Royal Air Force. They are always working with an

eye to the future, devising something new for defence or offence. It may be a bomb or it may be a device for finding enemy aircraft in the dark, but whatever it is, it is something which is intended to keep us ahead of the enemy in equipment.

The medical profession's contribution to our air strength is not confined to treating sick or wounded men. The effect of flying on young men daily working under conditions of great strain is constantly under review. Special attention is paid to the very great problem of cold, to night vision, to a thousand and one other tricky questions associated with modern aviation. Largely as a result of their studies and researches the incidence of flying strain has been considerably lower than was expected before the war. Modern methods of treating burns, of dealing with fractures, of restoring confidence in men whose nerves may have been shattered—all these and many more have made an invaluable contribution to the R.A.F.'s success.

The Fleet Air Arm has done great deeds. Nobody needs to be reminded of the dreadful blow they delivered to the Italian Fleet in the harbour of Taranto. The Royal Navy would be the first to acknowledge the great value of its ship-borne aircraft. The F.A.A. is a complete air force in itself—one which Hitler and Mussolini would be prepared to exchange many hundreds of thousands of troops to possess.

For torpedo attack the Fleet Air Arm has Albacores and Sharks; in the Roc it possesses an outstanding dive-bomber; while the Fairey Fulmar is perhaps the best Fleet fighter in the world. It has many other types of machines,

including Americans. Only one other country—the United States—has anything comparable to our Fleet Air Force. Even those who shook their heads before the war and said that the aircraft-carrier was the most vulnerable target in the world are bound to admit that the naval air arm has justified itself over and over again.

Because the author has written without criticism of all the different branches which combine to carry on our fight in the air it should not be assumed that there are no weaknesses. There are bound to be some, but they are extremely few.

In any case, one is not going to draw the enemy's attention to them; let him find them out for himself.

Those who may be a little impatient for the dawning of the day when we shall start to give the German more punishment than we have had to take, may, if they have been patient enough to struggle through this book, begin to understand what a colossal task it is to build up a huge Air Force.

Much of the leeway caused by several years' start on the part of Germany has already been made up. With the satisfactory increase in the amount of American help and the ever-growing scale of our own production the day is not now far distant when the enemy will feel the full weight of the greatest Air Force the world has ever known.